Computerising Gentlemen: the Automation of the London Stock Exchange, c. 1945-1995

Juan Pablo Pardo-Guerra

PhD in Science and Technology Studies
The University of Edinburgh
2010

Declaration of Originality of Submitted Work

In conformance to the regulations of the University of Edinburgh, I hereby declare that:

(1) I am the sole author and composer of this thesis;

(2) this thesis is entirely my own work; and

(3) this thesis has not been submitted in part or whole for any other degree or professional qualification.

Signed _____

Date _____

Abstract

This dissertation concerns the development of market information technologies in the London Stock Exchange, c. 1945-1992. Based on archival research in London, Cambridge and Edinburgh, and 20 semi-structured interviews with former technologists, brokers, and market-makers, my dissertation identifies the social, technological and institutional factors that allowed dealings in bonds and equities to move off the trading floor of the Stock Exchange and onto competing electronic platforms.

My dissertation utilises the history of market information technologies as an occasion for producing a multi-layered analysis of the material, social, and regulatory transformations of finance in the City of London between c. 1945 and the mid 1990s. In particular, my dissertation deals with the rise of the so-called 'information age' in relation to British finance.

The analysis is carried out in three parts, each tackling a specific 'myth' on the role of information and communication technologies in contemporary finance. The first part (chapters 3-4) deals with the dematerialisation of finance, demonstrating the often ignored character of technologies, materialities and their associated expertise in the constitution of the market. The second part (chapter 5) deconstructs the concept of disintermediation by analysing the social history of broking and jobbing in post-war City of London. Specifically, this part argues that changes in financial practices amongst the membership of the Stock Exchange were neither determined by the adoption of computers nor defined by a pre-existing culture of gentlemanly capitalism. Rather, they derived from the adaptation of market participants to a changing economic and social environment. The third part of this thesis (chapter 6) engages with deregulation. In particular, it provides an account of three broad patterns of financial regulation in Britain and the emergence of the current understanding of financial markets as manageable entities. The dissertation finalises by exploring the role of 'informational metaphors' in mediating the practices, materialities and regulations of the London Stock Exchange.

For Nara and Samuel
For Lupe, Juan Pablo, Sebas and Gabi

Acknowledgements

This volume is but a single pebble in a road that stretches almost ten years. In its twists and turns, the journey on this road has not been solitary, however, and to those who have been with me I dedicate my work.

My parents, Juan Pablo and Lupe, invested their love and care in ensuring a happy beginning in life. They worked hard to provide their sons and daughter honest and intellectually rewarding careers, and for that I cannot thank them enough. In their efforts, big and small, quotidian and extraordinary, they prepared the road that we now walk. It is now in our hands to reach our personal horizons.

I also dedicate this work to my siblings, Sebastian and Gaby, who albeit from distance have been tremendous companions throughout this journey, friends throughout the course of life.

Researching this volume was a pleasure facilitated by the kindness and attention of those who spared their time to reminisce about an era long gone. My sincere thanks go to Peter Bennett, Peter Cox, Elroy Dimson, Scott Dobbie, Dugald Eadie, Pete Harris, David Hobbs, Michael Johnstone, Ian McLelland, Michael Newman, Barry Riley, John Scannell, and Nic Stuchfield, who generously provided their stories and guidance. My gratitude also extend to Simon Peter Buck, John Cheine, George Hayter, Patrick Mitford-Slade, Graham Ross Russell, Daniel Sheridan and David Steen, who over lunch, coffee or tea, and in the tranquillity of their homes, provided unique opportunities to rediscover the many histories of technology and finance in the City of London. Peter Buck, John Scannell, Ian McLelland, and George Hayter were particularly helpful in providing comments on the early drafts of chapters 3 and 4. Dr. Bernart Attard of the University of Leicester was also infinitely kind in providing access to his oral histories of jobbing, which provided inspiration for the first part of chapter 3.

This work would have been impossible without the guidance and support of my supervisors, Donald MacKenzie and Alex Preda, who offered comments, insights, suggestions, critiques and constructive feedback on several drafts of this and other documents. In more than one occasion, conversations with either Donald or Alex resulted in re-structuring arguments, revising theory and reconsidering the

weight of evidence. They were, as I said in the past and as I continue to feel, a supervisorial dream-team. Working with them was an immense pleasure and honour, one that I hope will continue in the future.

Hopefully, the reader of this dissertation will perceive here and there the marks of the Science Studies Unit. Having formed part of the SSU, from its days on Buccleuch Place to its present location in Chisholm House, was an honour impossible to exaggerate. But the honour came not from the fetish of being in the birthplace of the Edinburgh School in the sociology of scientific knowledge. Rather, honour derived from having met a wonderful group of researchers who, in the office, in the pub, and in the warmth of their conversations made Scotland feel like home. Pablo Schyfter, Geth Rees, Isabel Fletcher, Donna Messner, James Wood, Monica Garcia, François Briatte, Olga Morawczynski, Nathan Gove, Morgan Huang, Graeme Beale, Josipa Petrunic, Joao Rangel, John Henry, David Bloor, Steve Sturdy, Lawrence Dritsas, Emese Lafferton, Ivan Crozier, and Wendy Faulkner are all people I consider good friends. The homeliness of Edinburgh, however, was undoubtedly the product of Carole Tansley. It was an honour and privilege that I will forever keep in my mind to have been part of the Science Studies Unit in the Age of Carole.

The community at the University of Edinburgh and beyond is also to thank, including Emre Tarim, Svetlana Milyaeva, Lucia Siu and Robin Williams. Alejandro Nadal and Francisco Aguayo from El Colegio de Mexico provided much encouragement in the early days of my research. Conversations with participants at 4S Rotterdam and HISRECO 2009 – both directly and indirectly related to the matter of this volume – were welcomed opportunities to digress about the life of a postgraduate student. In the later stages of its production, Bernardo Batiz-Lazo provided useful and critical comments on several parts of this dissertation. I also appreciate sincerely the opportunity to present some of my results to the NECSO group at the UFRJ in Rio de Janeiro; for this, I thank Ivan da Costa Marques for his tremendous help and hospitality. I also thank Karin Knorr-Cetina, for her extremely kind support.

I also thank chance, for having been born in an age when ‘Ctrl + F’ has profound cultural (and practical) significance. However ironic it may seem, the

critique of the information age contained in this volume was facilitated by the proliferation of information services on- and off-line, including Google, JSTOR, and Word. After scouring – for pure curiosity – dissertations from pre-digital times, I must recognise the wonder that is the digital world.

I thank wholeheartedly my wife, Nara, with whom I started a shared road almost five years ago. Our path in Scotland took unforeseen turns and twists, ups and downs, but in the face of it all, she remained a loving, caring partner and friend. We have built a home, given our time and love to Oyin, Fun Fun and Ata, and we will soon receive Samuel into the family. To Nara I give my thanks, for her patience, support, love, and affection, her joy, happiness and strength. These are all I need, and all I value.

Although produced in interaction with others, the errors and omissions of the thesis remain entirely my own. For these, I apologise beforehand.

This project would have been impossible, were it not for the generosity of CONACYT, who provided financial support throughout my postgraduate training through the Postgraduate Fellowship 192297.

Table of Contents

Glossary

Of the market

Bargain: a transaction to buy or sell shares in the Stock Exchange.

Bear market: a market characterised by a fall in the price of a single or several securities.

Bid: the price at which a jobber or market maker was willing to buy stock or shares in the market.

Blue button: an unauthorised clerk, so called because of the blue badges they wore.

Bond: a fixed-interest security issued by local authorities or corporations.

Broker: a member of the Stock Exchange who acted as the agent of investing clients on the floor of the Stock Exchange.

Box: a small room adjacent to the floor of the Stock Exchange, used by the dealing staff of broking firms.

Bull market: a market characterised by an increase in the price of a single or several securities.

Gilt *also* Gilt-edged: the term used to refer to British government-issued securities.

House: The colloquial term used for the premises or trading floor of the Stock Exchange.

Jobber: before 1986, a member of the Stock Exchange who acted as a market maker, buying and selling shares and stocks from brokers on his or her own account.

Merchant bank: a banking institution that engaged in project finance, investment management and planning securities issuance. Merchant banks were largely absorbed by investment banks and, eventually, consolidated with commercial banks.

Offer: the price at which a jobber or market maker was willing to sell stock or shares.

Put through: a broker who receives orders to buy and sell the same security from different clients is permitted to match one against the other after offering them to the market through a jobber.

Quotation: a dealing price in the market or a mid price as registered in the Stock Exchange Official List.

Share: a certificate representing one unit in the ownership of a corporation or mutual fund.

Stock: a certificate representing one unit in the ownership of a corporation or mutual fund. In Britain, ‘stock’ could referred to debt before the 1970s.

Ticket: a paper slip, prepared by the buying broker, to identify a purchase; tickets were passed to the Settlement Department.

Touch: the difference between the highest bid and the lowest offer in the market.

Turn: the spread between the bid and offered price quoted by a jobber or market maker.

Unauthorised clerk: an employee of a member firm of the Stock Exchange admitted to the trading floor but that was not allowed to deal in securities.

Waiter: the name given to the uniformed attendants of the Stock Exchange before 1986.

Of the organisation

ASG: Advanced Systems Group (c. 1982-1990); a group led by Peter Bennett, responsible for blue-sky innovation in the Stock Exchange.

Committee for General Purposes: the organ of the Stock Exchange that, up to 1947, represented the members of the Stock Exchange.

Committee of Trustees and Managers: the organ of the Stock Exchange that, up to 1947, represented the owners of the buildings of the Stock Exchange.

DISS: Directorate of Information Systems and Settlement (); the division of the Stock Exchange led by George Hayter responsible for developing and maintaining the systems for the market.

SSG: Special Systems Group (1977-1984); a group led by Peter Bennett, responsible for developing Exchange Price Information by Computer.

Of the technologies

Argus: a series of industrial control computers developed by Ferranti (Manchester) between 1958 and 1976. The Argus 400 used by the Stock Exchange relied on silicon transistors, and was based on a 12-bit word length with 24-bit instructions.

CHARM: CHecking, Accounting and Reporting for Member Firms; a bargain checking and reporting system introduced by the Stock Exchange in the mid 1970s, as part of the first phase of the settlement system, TALISMAN.

CRS: Computer Readable Service; a system that allowed users (including member firms, banks and investment managers) to connect their proprietary information systems to the databases of EPIC.

DEC: Digital Equipment Corporation; an American computer company and the vendor of PDP and VAX minicomputers throughout the 1960s and 1970s.

EPIC: Exchange Price Information by Computer; a price and company news information system developed and provided by the Stock Exchange starting in 1977. Unlike the Argus 400, the computer at the heart of EPIC contained a database of prices and company news that was accessible through digital links. EPIC thus made possible distributing digital rather than analog content to users.

IDN: Integrated Data Network; an unfulfilled plan conceived between 1981 and 1984 to standardise the technological platforms of the Stock Exchange by creating a single system

for market information, order routing and settlement.

MANTIS: MArket aND Trading Information System; a system planned by the Stock Exchange and ultimately replaced by SAEF that aimed to automate the execution of small trades.

MPDS: Market Price Display Service; a black and white mid-price broadcast system developed by the Stock Exchange in conjunction with Ferranti in 1969. The system relied on a series of input terminals located on the floor of the Stock Exchange, where prices were entered into an Argus 400. The Argus 400 generated a digital feed that was then transformed into an analog signal by a video converter. The signal was broadcast via a closed circuit coaxial cable network throughout the City of London in 22 channels.

PDP-11: a series of 16-bit minicomputers developed by DEC and designed for use in real-time applications.

SAEF: SEAQ Automated Execution Facility; a small order automated execution system introduced by the Stock Exchange in 1988.

SEAQ: Stock Exchange Automated Quotations; a quotation reporting system introduced by the Stock Exchange in Big Bang in 1986 that presented all the bids and offers for the most active shares in the market and allowed dealing to be conducted over the phone.

TOPIC: Teletext Output of Price Information by Computer; videotext service introduced in 1980 that offered price and company news information to subscribers throughout Britain and the world. Unlike its predecessor, MPDS, TOPIC was based on an asymmetrical communication channel (users were not limited to receiving a set broadcast but could request information to the computer). Data displayed on TOPIC came from EPIC and was distributed via conventional and dedicated phone lines to terminals across the world.

TALISMAN: Transfer Accounting and Lodgement for Investors, Stock MANagement for jobbers; an IBM-based settlement system introduced by the Stock Exchange in order to streamline account and bargain matching, reducing the need of clerical workers in the settlement room and increasing the speed of bargain reporting.

VAX: a 32-bit minicomputer developed by DEC to replace the PDP-11 series.

1 Introduction

> The world isn't run by weapons anymore, or energy or money. It's run by ones and zeroes, little bits of data. It's all just electrons. […] There's a war out there, old friend, a world war. And it's not about who's got the most bullets. It's about who controls the information: what we see and hear, how we work, what we think. It's all about the information.
>
> Cosmo (Ben Kingsley) in *Sneakers* (1992)

I started research for this volume in late 2006, nearly twenty years to the day after the London Stock Exchange's Big Bang. At the time of my initial investigation, the recent financial crisis was still in the making, nothing more than a faint possibility in a far away horizon. Indeed, if anything, the moment was one of celebration for British finance: after more than nine decades of American supremacy over the international financial system, the City of London could once again boast that it outranked New York as the largest capital of capital in the world (Timmons, 2006). Two decades of organisational reconfiguration, pervasive technological innovation, and carefully engineered governmental intervention transformed London into the brightest star in the constellation of global finance.

Today, the record-breaking days of the FTSE are long-gone and all that seems to remain is the memory of a more prosperous past. That and the vast array of institutions, practices, materialities, connectivities and vocabularies built over centuries as the supports of finance. In seeking to understand the nature and character of these supports, this dissertation explores the design, adoption, diffusion, and apprehension of information and communication technologies within the London Stock Exchange between circa 1945 and 1995. Specifically, this volume utilises the history of market information technologies as an occasion for producing a multi-

layered analysis of the material, social, and regulatory transformations that embedded the London Stock Exchange from the end of the Second World War to the mid 1990s. In doing so, the discussions presented in this volume serve as a basis for apprising both sociological accounts of the recent history of British finance as well as broader debates on the technological character of the marketplace.

1.1 Caught in the information age

The sociological literature on finance portrays Big Bang as a fundamental discontinuity in the practices, structures and cultures of the City of London – the historical, geographic and figurative centre of the British securities industry. Paradigmatically, the work of Manuel Castells, widely deemed a foundational author for understanding the dynamics of the so-called information age, presents Big Bang as the 'turning point' in a process of global deregulation that set the grounds for a 'new financial freedom [allowing] capital from all sources to be mobilised from anywhere to be invested anywhere' (Castells, 2000c, p. 104). Elsewhere, Big Bang is similarly rendered a watershed – both factual and symbolic – in the evolution of British finance: for some, it marked London's début as a global city (Sassen, 1999); for others, it demonstrated the technologically-mediated end of geography in financial services (O'Brien, 1992); and yet for others, it exemplified the birth of a new global economic order (Strange, 1986). Big Bang was thus 'liberalisation', 'opening-up', 'deregulation', 'transformation', 'boom', and 'culmination'. In sum, it was the beginning of a new era, the exemplar of the future of finance.

The transformations of Big Bang, we are suggested by Castells, were defined by two specific processes. The first was strictly regulatory. Big Bang and the broader reordering of the British securities industry during the 1980s was framed by a calculated process of deregulation, whereby cross-border transactions were 'liberalised' and the 'cartel' of the Stock Exchange was disassembled. These two changes resulted in a flight of capital into London, leading to a reconfiguration of the securities industry and the subsequent consolidation of the City as one of the pillars of global finance (Moran, 1988; Moran, 2003; Hamilton, 1986; Vogel, 1996; King, 1990).

The second process was overtly technological. Along with the regulatory overhaul of 1986, Big Bang entailed the introduction of a suite of novel platforms and services to the market. These included the screen-based market information services SEAQ and SEAQ-I (for Stock Exchange Automated Quotations, and Stock Exchange Automated Quotations International, respectively) that, in conjunction with the telephone, resulted in the demise of face-to-face dealing on the Stock Exchange's trading floor. Big Bang thus signalled London's transition towards a 'new informational economy', incorporating its markets into a system in which

> all earnings from all activities and countries end up being traded. This global financial market works only partly according to market rules. It is shaped and moved by information turbulences of various origins, processed and transmitted almost instantly by tele-communicated, information systems, in the absence of the institutional regulation of global capital flows (Castells, 2000b, p. 11) […] The outcome of […] financial globalisation may be that we have created an Automaton, at the core of our economies, decisively conditioning our lives. Humankind's nightmare of seeing our machines taking control of our world seems on the edge of becoming reality – not in the form of robots that eliminate jobs or government computers that police our lives, but as an electronically based system of financial transactions (Castells, 2000a, p. 56)

As the world was tied together 'in almost real time' (Bell, 1977, p. 112), the technological reconfiguration of finance embodied the rise of a post-industrial epoch (see Bell, 1973). From Big Bang onwards, we are told, finance was increasingly a global technological affair.

1.2 Three informatic myths

Although the proliferation of information and communication technologies within financial spheres is an undeniable empirical fact of the twentieth century, the scholarship on the subject has so far tended to flatten the sociological facets of technological change. Effectively, the history of contemporary finance is narrated as a triumphal saga of technological efficiency, a collusion of tales of bold innovation and stories of decreasing trading costs, wider corporate ownership and greater regulatory control. As a subsection of this literature, accounts on the digitalisation of finance are no exception. As demonstrated by extant analyses of Big Bang, the scholarship on the most recent wave of technological change within finance

approaches the issue as a fundamental historical discontinuity. The late, though ultimately revolutionary, adoption of computers and telecommunications in the securities industry, for instance, is rendered the most important change in finance in the last century (Cortada, 2005). Likewise, the very structure of financial markets is deemed a pre-determined consequence of the rise and consolidation of the (digital) information age (Castells, 2000a).

In presenting technology as a transformative force, however, authors have committed three important omissions. First, following the basic metaphors of the neoclassical theory of production, they present information technologies as ready-made inputs that emerge from the black-box of the information age. Second, by rendering technologies as external inputs, they tend to present financial organisations as adopters rather than developers, clients rather than designers. The financial services industry, it would seem, only embraced innovations 'once it made economic sense to do so' (Cortada, 2005). Third, even in the rare instances when innovation is the explicit object of analysis, it is portrayed as a linear process driven by the diverging forces of market demand and technological pull (for a discussion on these explanations, see MacKenzie & Wajcman, 2003; Williams & Edge, 1996).

Examples of these omissions are numerous. Charles R. Geiss' history of Wall Street, for instance, conspicuously leaves technological change unattended (Geiss, 2004). Similarly, Ranald Michie's meticulous history of the London Stock Exchange mentions the proliferation of technological systems in the market almost in passing, without reference to the trials and tribulations of their development.

Engaging with the transformations of British finance that gave form and figure to Big Bang requires constructing a nuanced history of both deregulation and the adoption of information and communication technologies, avoiding the revolutionary – and ultimately sociologically opaque – rhetoric of the information age (e.g. Chandler & Cortada, 2000; Cortada, 2005). Such a study must start from the recognition that, however important in modern societies, digital technologies are no more central to the organisation of the marketplace than, say, specific valuation

techniques or particular cultures of accountancy. To imply that a circumscribed domain of the 'digital' imbricates a separate domain of the 'social' (Latham & Sassen, 2005) is to lose sight of the contingent and situated character of technology, knowledge and practice. Analyses of change in finance are not served by upholding dichotomies of digital/analog, technological/social, future/past, and revolution/tradition, all of which fail to capture the subtleties of the sociotechnical interactions that bound and structure market institutions.

Much of the work performed in the following pages reconstructs the recent history of British finance by critically assessing a set of myths (see Barthes, 1993) that emerged from the rhetoric of the information age as applied to finance. In deconstructing these myths, the accounts here presented illustrate the uses, mobilisations, and reconfigurations of information and communication technologies in the financial marketplace of the London Stock Exchange. Based on notions of information as the token of social and economic interaction, these myths are constituted by a series of teleological imaginaries that inflect the destiny of society and the market with the affordances of information and communication technologies. The future, in this mythology, is digital, a landscape populated by creatures bearing the prefixes of '*i-*', '*e-*', '*cyber-*' and '*info-*'. Like comparable semiotic structures elsewhere, the mythology of the information age is thus an ambiguous meta-language, distorting, deforming and naturalising the technological operation of the marketplace.

The myths here dissected are three. The first is a direct implication of accepting the information and communication technologies as entities that can capture, represent and process market interactions in their entirety. Insofar as finance is seen as the processing of information (e.g. Fama, 1970), it is deemed an arena that can be 'dematerialised', stripped of its awkward physicality and reduced to the virtual (and virtuous) purity of information flows. The possibility of dematerialisation is clear in the vocabularies of commentators of high modernity: today's markets, it is said, exist 'in a kind of [globalised] cyberspace in which money capital has reached its ultimate dematerialisation, as messages that pass

instantaneously from one nodal point to another across the former globe, the former material globe' (Jameson, 1997, p. 260). While dematerialisation was originally confined to the technical vocabularies that described the possibility of computerising paper certificates to reduce settlement and clearing costs (Cerny, 1994; Hamilton, 1986), the metaphor soon acquired greater ambitions, growing into an all-encompassing term for extrapolating the hyper-mobile economies of the future (e.g. Colombo, 1988; Junne, Komen, & Tomei, 1989; Trainer, 2001; Kander, 2005).

Compounded with the alleged ability of computers and telecommunications to capture the financial marketplace, finance is the subject of a second myth. Just as technology enabled the elimination of material dependencies, it also facilitated severing social connectivities. Technology, in particular, allowed investors to disintermediate their dealings, bypassing human brokers and market-makers with unhuman networks of computer code (Barber & Odean, 2001). For the myth of disintermediation, the deployment of alternative trading systems and electronic communication networks within the securities industry demonstrated technology's ability to offer unmediated access to the informatic ebbs and flows of global finance (Ming, Stallaert, & Whinston, 2004; Allen, McAndrews, & Strahan, 2002). In the financial markets of the new economy, growth, efficiency, access, safety, risk and equality and were cast in informatic moulds (Atkinson, 2004; Castells, 2004; Claessens, Glaessner, & Klingebeil, 2002).

Finally, contemporary finance was captured by a third myth. Technological innovations within the securities industry, we are told, flattened the world (O'Brien, 1992), prompting an aggressive agenda of deregulation that aimed to contain the global flows of capital within the boundaries of nation-states. Through the economic incentives of deregulation, the space of flows is temporarily immobilised in a place of space. But deregulation was not merely a matter of eliminating rules, of reducing intervention in the market and attracting flows to place. Deregulation involved delegating trust to technology, subordinating the regulator to the broader machinery of the market. Technology created an unprecedented 'transparency' (Nieto, 2001), solving the market's fundamental problem of asymmetric information. Intervention

thus became a matter of objective undesirability: after all, constituted by technologically mediated information flows, efficient markets provide 'the most potent protection possible for investors' (Saari, 1977, p. 1076)

1.3 Making finance in the London Stock Exchange

This volume utilises the three myths briefly introduced above as a subtext for analysing the material, social, and regulatory transformations that embedded the London Stock Exchange in the years of the putative rise of the information age. Each of the following chapters, each critique of a myth, then, represents a different aspect in the career of the London Stock Exchange. In exploring these careers, each chapter provides a glimpse – perhaps fragmented, perhaps incomplete, but insightful nonetheless – of the changes that characterised late twentieth-century British finance.

This volume does not pretend to be the first to approach the information age from a critical standpoint. Critical analyses of the information age (Webster, 2006; Sholle, 2003) and of some of the myths of the 'new economy' (in the case of disintermediation, see French & Leyshon, 2004; for regulation, see Vogel, 1996; for dematerialisation and ICTs, see Sassen, 2002) are plentiful elsewhere. The contribution of this study resides in supplying a historical demonstration of the co-evolution of information and communication technologies, financial practices, social connectivities, and organisational regulations in the ongoing construction of the London Stock Exchange and its markets.

The theoretical approach of this exploration is inspired in the traditions of science and technology studies (MacKenzie et al., 2003; Williams et al., 1996; Bijker & Law, 1992). And within the diverse collection of approaches within science and technology studies, this volume is particularly influenced by the performative theory of social institutions as forwarded by Barry Barnes, David Bloor and Martin Kusch (Bloor, 1997; Kusch, 2002; Barnes, 1983; Barnes, 1995). Based on the sociology of scientific knowledge as developed in Edinburgh during the 1970s, the performative theory of social institutions provides a subtle, though robust, theoretical scaffold for several parts of this project. In engaging with an overtly economic topic, this volume

also forms part of a larger body of social scientific literature located at the intersection of several established disciplinary domains, from new economic sociology and the sociology of markets, to business studies and economic anthropology (Pinch & Swedberg, 2008; Callon, 1998; Knorr Cetina & Preda, 2005; MacKenzie, 2009; MacKenzie, Muniesa, & Siu, 2007).

The discussions presented in this volume, furthermore, stand on a solid corpus of historical and sociological scholarship on the financial communities of the City of London. Prime amongst these is Ranald Michie's exhaustive account of the history of the London Stock Exchange (Michie, 1999). I dare not compete with Michie's historical proficiency: his narrative is meticulous and his descriptive breadth is bolstered by what seems to have been an unprecedented access to the private records of the Stock Exchange. To Michie's account, I offer a complementary narrative in the form of the testimony of technologists involved in building the platforms of the market between c. 1968 and 1992. While business history has tended to neglect the technical and bureaucratic underbelly of financial institutions – the engineers, secretaries, analysts, accountants, clerks, janitors, et al. that, through their everyday activities, produce organisation through time – here I seek to bring their contributions to the fore. Paraphrasing Bruno Latour's renowned essay (Latour, 1992), in at least two chapters of this volume, I search for the missing engineers.

Alongside Michie's work, the histories of David Kynaston, William Reader, and Michael Reed contextualise this study. While Kynaston's *oeuvre* arguably offers some of the most detailed accounts of the City of London's social life and the operation of its principal institutions, Reader and Reed presents – albeit in a sometimes celebratory and institutionally sanctioned mode – the history of some of Britain's merchant banks and stockbroking firms. Operating with an altogether different rationale, Alex Preda's recent *Framing Finance* (2009) prefaces the sociological discussions presented in this volume by offering a study of the emergence and consolidation of modern finance in the nineteenth and early-twentieth century, including debates on the meaning and use of information in the market.

1.4 Synopsis

This volume is structured around three substantive themes, each dealing with one of the abovementioned myths of the information age. In deconstructing these myths, each theme engages with a specific aspect of the social and institutional life of the London Stock Exchange.

The first theme of this volume is dematerialisation. This is approached by presenting an account of the adoption and diffusion of information and communication technologies in the Stock Exchange. Chapter 3 examines the early days of technological adoption, focusing on the development of the Stock Exchange's first computer-based market information dissemination systems. The story presented in chapter 3 opens with the mutualisation of the Stock Exchange in 1947 and closes with the introduction of the competing electronic trading platform ARIEL in the early 1970s.

While chapter 3 deals with the early stages of technological development, chapter 4 describes the consolidation of the technological culture that surrounded the creation of market information dissemination systems within the Stock Exchange. In particular, this chapter explores the rise and expansion of the Special Systems Group – the department charged with developing most of the information systems for the marketplace. As this chapter explores, the Special Systems Group and its organisational correlates were instrumental in shaping and managing the technological trajectory of the Stock Exchange's markets. Equally relevant, this chapter demonstrates that the digitalisation of the Stock Exchange was characterised by the proliferation of materialities, represented both by the novel technological platforms for the marketplace as by the organisational infrastructures required for maintaining and supporting exchange.

The second theme of this volume is disintermediation. This myth is analysed in chapter 5 through a reassessment of the social history of stockbroking and stockjobbing in the Stock Exchange. Weighing the history of the Stock Exchange's membership in relation to innovations in technologies and investment techniques,

this chapter engages with the literature on so-called gentlemanly capitalism (see, paradigmatically, Cain & Hopkins, 1986a; Cain & Hopkins, 1986b). Following the insights of Eric Hobsbawm (2008), however, this chapter represents gentlemanly capitalism as an invented tradition and, in doing so, opens a space for understanding the different modes of technological adoption within the member firms of the Stock Exchange. As is shown, technological adoption within the market was associated to a re-intermediation of finance in London which included, among other things, the redefinition of the professional identities of brokers and jobbers vis-à-vis new modes of apprehending market information.

Part three of this volume delves into the alleged deregulation of finance in the City of London. Deregulation is a critical theme, insofar as it is identified as the catalyst of financial globalisation and the consolidation of the information age in international markets. Rather than being a removal of rules – as its etymological provenance would suggest – deregulation in the 1980s is here represented as a process deriving from the introduction of bureaucratic imperatives into the organisation of the market. This was exemplified, for instance, in the adoption of economic techniques for assessing and surveying finance. As argued in chapter 6, the adoption of these techniques was itself catalysed by a series of internal and external crises of confidence and organisational readjustments that led both market participants and government to find novel solutions to a certain problem of authority. The exploration of chapter 6 consists of analysing the regulatory history of finance in and around the London Stock Exchange. By tracing the outlines of such history, this chapter highlights three broad transformations in the regulatory discourses of British finance.

Chapter 7 approaches the themes discussed in this volume by analysing the mechanisms through which actors create markets with the use of metaphors. Chapter 7, in particular, introduces the theoretical concept of a market-making regime as shorthand for representing the sociologically-relevant mechanisms that social actors utilise to orient their behaviours in constituting specific manifestations of the market. Recurring to the work of Barry Barnes and John Dupre (2008), and the insights of

George Lakoff (1992; Lakoff & Johnson, 2003), this chapter draws a connection between metaphors and market-making regimes. In doing so, it presents an account of the use and mobilisation of the so-called informatic metaphor in constituting the markets of the London Stock Exchange.

1.5 A brief note on terminology

The discussions presented in this volume hinge on three interrelated, though empirically and theoretically distinct, concepts: those of myth, imaginary and metaphor. For the benefit of clarity, I will make explicit the differences in said concepts, thereby disentangling possible confusions that might arise.

Myths – and the mythologies they create – are here understood in terms of Roland Barthes' semiotic approach (Barthes, 1993). In particular, myths are considered second order signs that hinge on 'ordinary' (first order) signs but to which something, such as a certain ideological content, has been added. Following Ferdinand de Sausseur's semiotics, Barthes presents the first order of communication as composed of signs in which the signifier and signified are associated according to a particular, though arbitrary, convention. In myths, however, the sign is itself a signifier, or, in other words, stands for something. The meaning of myths, however, is not arbitrary: rather, it is purposefully attributed, carefully constructed. In this sense, myths are ideological. Within the discussions presented in this volume, dematerialization, disintermediation and deregulation operate in this sense: while they may refer to concrete things – for instance, in the case of dematerialisation, to the elimination of paper-based certificates – they also signify broader processes – for example, the hyper-mobility of global finance.

Imaginaries, on the other hand, are complex symbolic systems shared by particular communities. Specifically, I rely on Charles Taylor's definition of social imaginaries, which are understood as collectively shared systems of reference used by individuals to imagine their social existence, their obligations towards others, their expectations of behaviour, and the normative notions and images underlying these expectations (Taylor, 2004). Importantly, given that they are shared by large

social groups, social imaginaries are reservoirs that allow collectives to articulate a sense of legitimacy. Imaginaries are therefore different from myths: although they have an ideological dimension, they are constructed by collective accord and are less defined in their meaning.

Finally, wherever references to metaphors are made, these follow the conceptual framework proposed by Lakoff & Johnson (2003). Metaphors, in particular, are understood as linguistic associations between different domains of experience and thought. For Lakoff and Johnson, such associations coordinate action across differing domains. As they note, 'the concepts that govern our thought are not just matters of the intellect. They also govern our everyday functioning, down to the most mundane details. Our concepts structure what we perceive, how we get around the world, and how we relate to other people. […] The essence of metaphor [in this framework] is understanding and experiencing one kind of thing in terms of another' (p. 3-5). Hence, and unlike myths and imaginaries, metaphors are not purely symbolic; importantly, they are experiential modes of cognition that allow for comparisons and interpolations to be made.

Before I proceed to the details of this story, before I venture into the black boxes of finance in the twentieth century Stock Exchange, I shall offer some thoughts on theory and methodology.

.

2 Studying Markets and their Machines

Michel de Certeau once noted that writing history starts with the construction of a sentence, with the act of filling the blank surface of a page. To produce history in Certeau's sense is to commence a new time, to distance our present from our past, vacillating between a reference to practices and the creation of a closed discourse (Certeau, 1988). Writing, categorising and reconstructing – all elements of producing history – are thus a creation of boundaries, acts that define what is within and what is without.

Tracing boundaries is arguably an inescapable part of the creation of the historical text, a step that has to be taken to provide author and reader, manuscript and audience, the limits of their mediated interaction, an outline of the rules of the game. The rules of this game, the limits of this particular exploration, are the subject of this chapter. Showing these limits and the roads taken to create this text, this chapter situates my study within the webs of sources, methodologies and theories used in its creation.

2.1 Sources and resources

The initial boundaries of this study are given by its theme. In its design, the discussions of this volume are constrained to the analysis of the technological infrastructures, financial practices, economic discourses and regulatory instruments deployed within and around the London Stock Exchange. Spatially and materially, this involves centring my account on a finite set of individuals, organisations and artefacts that were related to the financial community of the London Stock Exchange. Temporally, this thematic selection further implies focusing on events and processes that occurred during the second half of the twentieth century – although on some occasions my narrative meanders into earlier periods. As such, this text is engineered in the form of extended narratives as opposed to punctual comparisons. Rather than contrasting the London Stock Exchange to some other venue, the objective of this

text is to account for changes in practices and institutions within a specific subset of British finance in relatively recent times.

The spatial and temporal limits of this text derive in a second boundary, set by the selection of sources that inform the narrative herein contained. As any study informed by (and constitutive of) history, this project is prefigured by its sources, be they the archival records and interviews that empirically anchor the account, or the secondary narratives that provide links to the larger literature on British finance. Each source is unique, insofar as it is a specific manifestation of a past event, of a process, thought or interaction that was crystallised in physical form. To use a tactile metaphor, the threads used to weave this story have thus different lengths, strengths and consistencies, and it is through this diversity of materials that this story acquires its richness and form.

2.1.1 Archives and documental sources

The primary sources used in this study were obtained from a series of libraries and archives that are well-known to the historian of British finance. Without any doubt the most prominent among these, the archive of the Guildhall Library, London, houses the records of the London Stock Exchange as well as the collections of other City institutions. My use of the Guildhall Library, however, was somewhat limited by the scope of this project: while much of the automation of the Stock Exchange took place from the mid 1960s onwards, other than a couple of isolated instances, the corporate records of this organisation are only available for dates prior to the mid 1950s. A legal constraint made it impossible to access the minutes of the Council and Committees of the Stock Exchange – despite having sought permission in writing to the legal secretary of this organisation in late 2006. Similarly, whilst the archivist at the Guildhall Library kindly gave me a glimpse of two uncatalogued boxes of the records of the stockbroking firms Philips & Drew, most of the information therein found was already available elsewhere (Reader & Kynaston, 1998). Indeed, the archives of Philips & Drew at Guildhall contain discussions between William Reader and some of the brokers formerly involved with this firm, as part of the exchanges that preceded the publication of his book. An important exception within the Guildhall Library was a series of corporate documents published by the Council of

the Stock Exchange describing, among other things, its position vis-à-vis Big Bang and the role of technology in stockbroking in the 1980s. More than anything else, however, visits to the Guildhall Library – which I did almost ritualistically, in every opportunity I had when visiting London – provided me with a sense of the contents and vocabularies used by the Stock Exchange in its documents and, consequently, a small and admittedly partial sense of the everyday corporate culture of this organisation.

Most of the sources used in this study were spread throughout a handful of libraries. The British Library, London, contained a considerable number of publications by the Stock Exchange, including its *Rules and Regulations*, the *Code of Dealing*, the *Rules for Listings and Quotations*, as well as diverse pamphlets and magazines. In addition to these documents (which were overtly oriented at the internal audience of the Stock Exchange), the catalogue of the British Library contained several volumes of the proceedings of a series of conferences titled *Computers in the City* which, organised by George Hayter, were a crucial forum for discussing the technological innovations of British finance. Insofar as they captured the technological developments and imaginaries of the City of London, this study utilised these volumes as primary sources. An equally notable source of data was found in the National Sound Archive, also located in the British Library, which contains transcripts and recordings of numerous oral histories of finance and banking forming part of the City Lives Project.

In addition to the British Library, I consulted the collections of the National Library of Scotland, Edinburgh. There, I encountered a fundamentally important set of documents in the form of an (almost complete) collection of the *Stock Exchange Journal*. As a cultural object, the *Journal* provides a window into the everyday life of the Stock Exchange, the concerns of its membership, and the whims of the times. At a different level, the National Library of Scotland also housed several reports by the Office of Fair Trading, concerning the practices and regulations of the Stock Exchange in the late 1980s and early 1990s. These provided parts of the argument for chapter 6 and were the basis of a (failed) Freedom of Information Request that

sought to recover some of the consultations made at the time by the OFT with several financial institutions, in Britain and abroad. Unfortunately, such files were either discarded or destroyed, and apparently no records remain of the institutional discussions on the regulations of the Stock Exchange of the early 1990s within the archives of the OFT.

In different ways, the Bank of England Archives, and the archives of the London School of Economics and Political Science and King's College, Cambridge, provided snippets that, however reduced, contributed to my narratives. The records of the Bank of England, for instance, showed instances of the use of operations research in a British financial institution, whilst the records of Peter Shore at the London School of Economics contained documents issued by the Stock Exchange in the 1970s in defence of their practices. The immaculately preserved records at King's College, furthermore, provided data on John Maynard Keynes' views of the Stock Exchange during the Second World War.

Archival work was complemented with the opinions and temporalities portrayed and materialised in newspapers. The *Financial Times* was a particularly useful source of insights, as were *The Guardian*, *The Times*, *The Independent*, and the *New York Times*. While my initial explorations in these publications involved dealing with the physicality of microfilms, my work soon reached the realm of the digital archives of Factiva and Lexis Nexis – admittedly missing some of the context provided by a print newspaper. The accounts in newspapers and other periodical publications were utilised as indexes, in a sense, for the broader narratives, as elements that provided stubs on which to tie the story.

2.1.2 Interviews and personal communications

However detailed it may be, and however much it may represent the logic of bureaucratic life, the print medium is inert. In a project that deals with a relatively recent set of practices and events, documents are almost inadequately partial, insufficiently rich, forms of data. Seeking to provide a thicker texture to the narrative, the bulk of the materials used in this volume come from interviews with

technologists and market participants that were associated, in some way or another, to the Stock Exchange between 1968 and 1992.

The interviews forming part of this project were conducted between April 2007 and May 2008 and took place in several locations across the United Kingdom. In total, this project made use of 20 interviews of which 8 were with technologists; 6 with former brokers; 3 with former jobbers; one with a staff member of the Stock Exchange in charge of market supervision; one with an economist; and one with a former leading editor of the FT. In all of these cases, the interviews were in-depth, semi-structured, designed in the style of oral histories, and tailored to the specific careers of the interviewees. Practically, the interviews were digitally recorded and subsequently transcribed in a simplified format – the objective of the transcripts, after all, was to provide a narrative of technology in British finance and not to delve into a deeper analysis of the interviewees' discourses. The list of potential interviewees was compiled both by identifying important characters in the extant literature on British finance as through conventional snowballing techniques. The latter was particularly true of technologists, whose identities are often unaccounted for in the literature.

As a representation of reality, an interview is patently false. The human mind is a particularly fallible recording instrument. Similarly, the conversational techniques used to explore individual memories are bound to the subjective states and retrospective interests of interviewees. These are two arguments typically adopted by opponents of oral history and other forms of interview as the basis for historical research (Roper, 1996). These arguments fail to recognise two points, however. The first, widely discussed in the literature on historical and sociological methodologies, is that oral histories and interviews are particularly well-suited for providing detailed accounts of the microcosm of everyday life, of personal relations, of organisational and familiar interactions, and, precisely due to their situated character, of subjective and personal meanings and lived experiences (however much *ex post* they may be). Arguably, oral histories have proven their worth in capturing the lives of people marginalised in physical (i.e. print) sources – from miners, and

labourers to soldiers, women and engineers (Perks & Thomson, 1998). The value of the interview does not reside in the 'precise' veracity of its claims. Interviews are worthy instruments of reconstruction owing to a second point, namely, their interactive features, the fact that they are the product of a moment in which researcher and interviewee jointly create specific histories tailored to particular ends.

The interview is a conversation with a purpose (Bingham & Moore, 1959), and in cases where the interview is an instrument of research, the purpose of the project is critically consequential to the narratives obtained. In my experience, telling the interviewee that the purpose of the conversation was to explore, say, the history of technologies in the Stock Exchange produced a response that was qualitatively different from occasions when the expressed purpose was to look into the sociology of information technologies in the City of London. In the former case, interviewees tended to focus on the temporalisation of events, on presenting sequences of processes. In the latter, interviewees would refer to 'anecdotes' to illustrate the particular cultures of finance at different times and places, delegating temporalities to a second plane. Such reflexivity about the uses of their accounts, about the purpose of the conversation, was to be expected: several of the interviewees had practical familiarity with interviews that were used in historical, sociological and – quite notably – journalistic projects. As a researcher, I thus consciously represented this project with some latitude, thereby enticing specific *types* of responses (as opposed to specific *contents*).

As an instrument for qualitative analysis, the apparently endemic inaccuracy of interviews must not be seen as a straightforward obstacle for historical and sociological reconstruction. Apparent errors in the recollections of interviewees are at times possible signposts of broader webs of meaning. In this study, this is exemplified by my interview with Peter Bennett, who in recalling his time as a student at City University, mentioned having seen 'guest speakers, you know, from all over the world, top class speakers, Alan Turing, people like that'. Alan Turing, however, could not have been a speaker at City University whilst Bennett was there:

Bennett, born in 1944, was about a decade old when Turing died in 1954[1]. The mention of Turing, however, is consistent with Bennett's broader interest in computing theory, artificial intelligence, chaos theory and other areas. As such, it *signals* his interests and lineages as much as it misrepresents past events.

The quality of the data obtained from interviews is further supported by the fact that these instruments of research are interactive not only within a specific instance but, more generally, across the entirety of a project. The interview needs not cease when the recorder is turned off. On the contrary, the conversation can continue through time, complementing the narratives produced during the initial exchange with twists, turns, and critical comments. An interview, in a sense, is not limited to the conversation or its transcript. An interview 'here' can provide the questions and cues for an interview 'there'. Interviewees can communicate – albeit indirectly and through the mediation of the interviewer – across interviews, thus allowing them to judge, challenge and reinforce each other's accounts. And the interviewer can discuss the narratives obtained from previous interviews with future interviewees, complementing them with an additional layer of input. Effectively, throughout this project, most of the interviews were utilised to dissect the conventional accounts of technological innovation within the Stock Exchange, utilising each conversation as an opportunity to examine the limits of the narrative as built up to that date and to discover possible new elements of the story. This process resulted in saturation, when the main narrative of technological innovation was no longer augmented or criticised by new interviews. In addition, interviewees were provided with copies of the first drafts of some of these chapters. Their subsequent comments provided both corrections and nuances to some of the elements of the story.

2.2 Accounting for the past, theorising for the future

The documental sources, interviews and personal communications utilised in this study were intertwined to produce a multilayered account of different sociotechnical facets of the automation of the London Stock Exchange. As an instance of qualitative

[1] I owe this point to Donald MacKenzie, who identified the temporal inconsistency in Bennett's account.

research, this study adopts an 'interpretative approach' concerned with 'understanding the meanings which people attach to phenomena […] within their social worlds' (Ritchie & Lewis, 2003, p. 3). In reconstructing and interpreting the sources, this study sought to triangulate as much as possible – that is, to compare the details, narratives, dates, names, and putative facts in multiple sources seeking a degree of convergence in data (Blaikie, 2000). Data was thus corroborated across sources and secondary accounts – including newspapers and the extant literature on British finance – and elaborated by increasing, for instance, the depth and detail of documental material through interviews.

While triangulation was the main method by which I sought to achieve convergence in the data, the ultimate objective of this study and its methodological foundations was to produce a *compelling* narrative on the role of technology in the financial practices of the twentieth century London Stock Exchange. The degree to which a narrative can be deemed compelling depends, of course, as much on the robustness of its sources, its stylistic characteristics and its narrative coherence as it does on its ability to engage with broader discussions in the literature. Stylistically, this volume is admittedly populated by many nooks and crannies. The narrative, furthermore, is frequently interspersed by long quotations from interviews or documents. This use of the sources, however, is part of a conscious effort to showcase and integrate the voices of the interviewees. This is clearer in the earlier chapters and become less patent as theoretical issues increase in prominence throughout the remainder of this volume. Nonetheless, it is in this display of empirical materials where I seek to engage the reader; it is here where I seek to reconstruct in words – perhaps even recover – some of the patterns of the past.

But for it to be compelling, this study must be situated in relation to the purpose of its creation. The narratives here presented were engineered, in particular, as a form of intervention. Indeed, and arguably like other forms of history, the one here created is a modification of the present through a reconstruction of the past. This history does not constitute an account of reality as much as a 'story of' – whether a 'story of stability', a 'story of revolution', a 'story of conflict' or a 'story of

resolution' – with a theoretical objective (Griffin, 1995). The objective of this volume, however, is not to offer a story of enlightenment between history and sociology – such attempts at a disciplinary synthesis have had mixed results (Abbott, 1991). Neither is it to focus on the cultivation of a logic of explanation common to historical and sociological discourses (Abrams, 1980). This volume, rather, is an illustration of the scope, limits and explanatory possibilities of a gamut of theories (sociological, anthropological, historical and even economic) on markets, technology and social processes. Configured as a tool of exploration, this study therefore engages with a broad social-scientific literature, bolstering some theoretical notions while eroding others. In doing so, the ultimate objective of this study is to create a ground for future debate, to expand, create, reformulate and represent novel boundaries in text and in practice.

dematerialisation

3 Digitalising Finance: the History of Information Technology in the London Stock Exchange, 1945-1975

For an observer sitting at the edge of the long nineteenth century, the City of London of 2010 must seem an alien space. In its financial practices, social dynamics, and embedding materialities, finance conducted on the globalised banks of the Thames stands in sharp contrast to the images of an insular gentlemanly past said to characterise Britain's economic traditions.

Located at the core of this emblematic space, the London Stock Exchange bears the distinguishable marks of time. Today a public company whose shares are traded within the electronic market that it itself provides, the London Stock Exchange has changed in almost every conceivable way from its origins in the late eighteenth century: it changed venues; it expanded its reach by merging with provincial exchanges and creating new markets; it altered its staff in numerous occasions; it changed its codes and structure of operation; and it shifted from a club-like organisation that contained and regulated the market, provided centralised settlement services, acted as a trade association, and controlled the listing of new companies to occupy its current role as but an additional, competing, and subordinated electronic hub for digital market transactions.

In accounting for these transformations, information and communication technologies are often identified as catalysts of change. For authors across disciplines – from business history and organisation studies to law and sociology – twentieth-century finance was driven not only by the utility-maximizing forces of the market; the outlines of finance, for them, were shaped – perhaps even determined – by the adoption of information and communication technologies within the securities industry and society at large. From the telegraph to the telephone, from the computer to the internet, the invisible hand of economic rationality was given a modern complement in the technological appendages of the 'digital hand' (Cortada, 2005b).

Histories of contemporary finance that extol the functional role of information technologies in contemporary life conflate quite distinct events under a larger narrative of revolutionary change. We have been told to believe, both by scholars as by commentators, that we live in a world markedly different from our industrial past (Chandler et al., 2000). We live in a society founded on and dominated by knowledge, information, and immaterial services. We live, in the words of Manuel Castells, in the network age, a time in which everyday experience becomes absorbed by a technological matrix built upon the continuous ebb and flow of information flows (Castells, 2000a).

The intersection of the histories of finance, technology, and the information age is a foundry for numerous metaphors that mediate our understanding of where markets come from and where they might go. Acting at the level of myth, of second-order representations of larger ideological structures, these metaphors reduce, restate and simplify the behaviour of the world; in their brevity, they become readily transportable; and in their definitional blurriness, they become widely applicable. The purpose of this and the following chapter is to reassess the historical contingency of dematerialisation, one such myth of the information age in finance. A term coined to describe the conversion of paper-based certificates into electronic computer entries, dematerialisation became a synonym of the digitalisation of *haute finance* towards the 1980s when the stocks, bonds, certificates and myriad documents that populated the floors of stock exchanges and the offices of brokers, bankers and accountants became amenable to the computer; they became information; they became highly transportable, de-territorialized and standardised bits.

Indeed, like other tales of the adoption of information and communication technologies, the story of dematerialisation presents the recent evolution of finance as determined by the technological ability of investors and intermediaries to transcend their material bonds. As certificates were digitalised, place was rendered irrelevant; information could flow freely across the world, unhindered by the awkward physicality of trading floors, dealing pitches, and geographic space. In the

imaginary of the brave new world, money is a 'complete abstraction' (Kintzele, 1988), traders are massless entities who leave no footprints, 'only the ghosts of electrons' (Grundfest, 1988), markets are a continually evolving cybernetic epiphenomena of society (Mirowski, 2007), and the world is the ultimately a flat and interconnected marketplace.

This and the following chapters analyse the dematerialisation of finance by presenting the history of the development of information and communication technologies within the London Stock Exchange. In particular, these chapters mount a critique to the myth of dematerialisation by stressing the regular and pervasive presence of materialities in the politics and practices of finance. In deconstructing the myth, these chapters perform three tasks that are relevant for gaining a deeper understanding the sociology of finance and its technological make-up. First, what follows shows that the development and adoption of information technologies within the London Stock Exchange was part of a longer institutional process that included significant, if often ignored, changes to the operational structure of the organisation. The automation of the back and front-offices, then, was not carried out simply to solve specific problems or to make certain processes more efficient; in a broader sense, mechanisation and automation were a reflection of larger and outwardly oriented organisational strategies adopted by the Stock Exchange over time[2].

Second, the technological history of the London Stock Exchange shows that automation was intrinsically embedded in the organisational politics of British finance. It was not, in this sense, an instrumental response to the obvious possibilities of digital technologies. The benefits of automation were not at any point a given, and developing and incorporating technology required cultivating trust between

[2] The contributing role of technology to the structuration of large organisations has been widely studied within the specialised literature. Jannis Kallinikos (2002, 2005), for instance, has argued that the production and use of what Wanda Orlikowski (with Iacono, 2001) refers to as *IT artefacts* (which amount to an ontological mixture between the physical artefact and the social relations associated to its use and mobilisation) are central to the cognitive organisation of particular collectives – and, importantly, bureaucratic collectives such as large organisations. Indeed, as this and the following chapter will explore, the technologies developed by the Stock Exchange were not only cognitive instruments of market action but, importantly, led to the emergence of specific standards and institutional relations that had concrete effects on the evolution of the marketplace.

regulators, technologists, brokers, jobbers, and authorities of the Stock Exchange. The technological arrangements produced, furthermore, were in themselves political, acting as structuring platforms that brought into being specific formats of the market. The politics of the technological endeavour of the Stock Exchange were therefore concomitant to the definitional politics of the market.

In what constitutes an important corollary to the above, a third and final task is performed throughout this chapter: namely, the following pages erode the myth of dematerialisation by demonstrating the role of materialities in creating novel forms of market interaction and organisational expertises (see Sassen, 2002). While much of the literature on the use of information technologies in finance assumes a definite distinction between technical and financial expertise amounting to a deficit model of technical knowledge in the market, the history of the London Stock Exchange shows the co-evolution of different forms of relating to, and understanding of, the platforms of the marketplace. Through the development of technological systems for price dissemination and trading, technologists acquired expertise on the market; and through their adoption of information technologies, market participants acquired expertise on how technological systems worked. But this interaction was not merely an exchange. Out of it, new types of expertise emerged that substantially changed the character of finance.

3.1 Snapshots from a club

As other stories of contemporary societies, this tale starts at the end of the Second World War. Although tranquilizing, the end of hostilities in Europe in 1945 provided little practical relief to the equities market in London. Like much of the large financial institutions in Britain, the London Stock Exchange survived the war at great cost. The need to secure financial resources for the nation's military efforts required strict controls over the economy that translated into a redistribution of powers within the City of London. Far behind lay the times of liberal internationalisation, when the London Stock Exchange was the hub of global finance and the motor of a constantly expanding financial machine. As the dust of the war settled, it was clear that the Stock Exchange would share space with the two other national economic institutions,

the Treasury and the Bank of England. Effectively, in this brave new world, the Stock Exchange concentrated on enforcing market discipline between its members, 'so creating a climate of trust […] conductive to business' (Michie, 1999, p. 336).

Not all was stasis, though, and change that proved fundamental occurred in the form of a review of the mode of ownership of the Stock Exchange. Since its foundation as a subscription room in 1801, the Stock Exchange had reflected both the physicality of trade and the sociality of trust. In its activities, the Stock Exchange was driven by two committees, one representing the proprietors of the building that housed the market (the Committee of Trustees and Managers), and one representing the members, namely, the brokers and dealers that made the market (the Committee for General Purposes). For the proprietors, the building that enveloped the trading floor was an investment: they owned shares in the Stock Exchange and charged fees to those who used the marketplace, in return providing and maintaining the required infrastructure. Members, on the other hand, did not deal with the administration of their material surroundings (then referred to as 'the House'), but were obliged to guarantee the behaviour of their peers by dictating both the conditions for joining the organisation and the sanctions that followed when someone deviated from the norm.

The division between owners and users of the marketplace ended in 1947 when under increased uncertainty regarding the future of the securities markets in Britain the Stock Exchange mutualised[3]. From then onwards, the Council of the Stock Exchange, representing the interests of all the members of the organisation, would 'control the affairs and the transaction of business in the Stock Exchange, and manage and administer the property, moneys, funds and assets of the undertaking' (Council of the Stock Exchange, 8 March 1948; Cited in Michie, 1999, p. 332). And as explored below, the effects of such modification were not constrained to the

[3] The members of the Stock Exchange were concerned particularly by the possibility of nationalization. As part of the government's attempts to secure control over the country's monetary policy, the Bank of England was nationalized in 1946. With nationalization, the Treasury was granted the power to give specific 'directions' to the Bank of England though, according to Philip Geddes, up to the mid 1980s this deterrent was never used. The cooperation between the Bank of England and the Treasury was based on informal relationships that depended on the personalities of the leadership of both organisations (Geddes, 1987).

administrative life of the Stock Exchange; rather, they percolated into British finance at large.

The organisational effects of mutualisation were not immediate, absorbed by the bear market that followed the end of the war and the redefinition of the boundaries of authority amongst City institutions. Indeed, in the opinion of historian Ranald Michie, constant struggles and negotiations between the Stock Exchange, the Treasury and Bank of England overshadowed the period between 1945 and 1965. Whilst the Stock Exchange sought to reduce or altogether eliminate competition from non-members upon which it had no regulatory control, the Treasury and Bank of England had as their priority stabilising the national economy. In this environment, sections of the Stock Exchange withdrew to conservative positions. Practices from the past, such as the use of options as instruments for managing risk, were abandoned temporarily since they conflicted with the type of markets forwarded by the government (options, in particular, were seen as merely speculative and as having no use in the marketplace). And, in broad terms, the quest to guarantee the centralisation of the equities market dominated the institutional life of the Stock Exchange.

The concerns of the membership of the Stock Exchange regarding the centralisation of the market were not entirely unfounded. The floor of the House – as members referred to the trading floor of the old Stock Exchange building – was arguably the most important technological support of the securities market in London. The trading floor not only configured the market in spatial, cognitive and physical sense, but by the sheer presence brokers, jobbers and clerks it constituted the main centre of liquidity of the British equities and bonds market.

To refer to the trading floor as a centre of liquidity should not conceal its patent materiality. On the contrary, liquidity was a consequence of the interaction between people and things. The trading floor of the late 1940s and early 1950s was housed in a building erected in 1853 on the site of the first Stock Exchange. Historically, this space had grown in a fragmented manner, with particular areas devoted to trading in specific types of securities. To some extent, this geography of

the trading floor emerged as a matter of practicality: the proximity of dealers that specialised in similar shares implied walking less when searching for the best price in the market. This arrangement, however, also reflected decades of economic growth, as the expansion and creation of companies and industrial sectors required space where to trade the securities associated to these ventures. At its origins in the late eighteenth century, the Stock Exchange specialised in trading government-issued debt ('gilts') and a reduced number of joint-stock shares. But as the foreign debts of budding Latin American nations became popular investments during the first decades of the nineteenth century, trading in these instruments was incorporated onto the floor. Railway shares followed a similar path in the mid 1800s, as did the mining and exploration shares that resulted from colonial expansion at the turn of the century. By the 1940s, the Stock Exchange had gone through two buildings (1802 and 1854) and a major refurbishment (between 1883 and 1885), resulting in a visually and architecturally heterogeneous space 'dominated by [a] great echoing dome and broken through its length by rows of supporting columns' (Attard, 2000, p. 9).

The trading floor of the Stock Exchange was the veritable core of the market. Indeed, it was not merely a locale in which brokers and dealers casually engaged in exchange. This confined space guaranteed the possibility of exchange through the presence of the particularly tight-knit and knowledgeable community that constituted the staff and membership of the Exchange[4]. The floor was, effectively, a device for the production and circulation of market knowledge. Orders to buy and sell shares and bonds were collected on the periphery of the floor, in small rooms operated by broking firms. Referred to as 'boxes', these rooms constituted a pied-à-terre of brokers within the market, 'containing a number of telephones direct to the firm's switchboard and to important clients, and in some cases telex machines or teleprinters for direct contact with provincial exchanges and other centres throughout

[4] The creation of liquidity in London was based upon a specific division of labor on the floor of the Stock Exchange, mentioned below, whereby market-makers (called jobbers) were obligated to provide two-way quotes on the shares they traded in. However, the qualities of liquidity (e.g. the spread between bids and offers) were also influenced by the interpersonal knowledge of the tight-knit community of market participants. Thus, liquidity in the Stock Exchange was contingent both in a hard form of social structure (organisational) and a soft one (interpersonal, related to status groups and relations of trust between market participants). This is further discussed below. On the sociology of liquidity, see (Carruthers & Stinchcombe, 1999).

the world' (Hamilton, 1968, p. 49). Staffed by both brokers and clerks, communicated to the main offices of the firms, and located on the edge of the market, the boxes served as convenient devices for interpreting and circulating data.

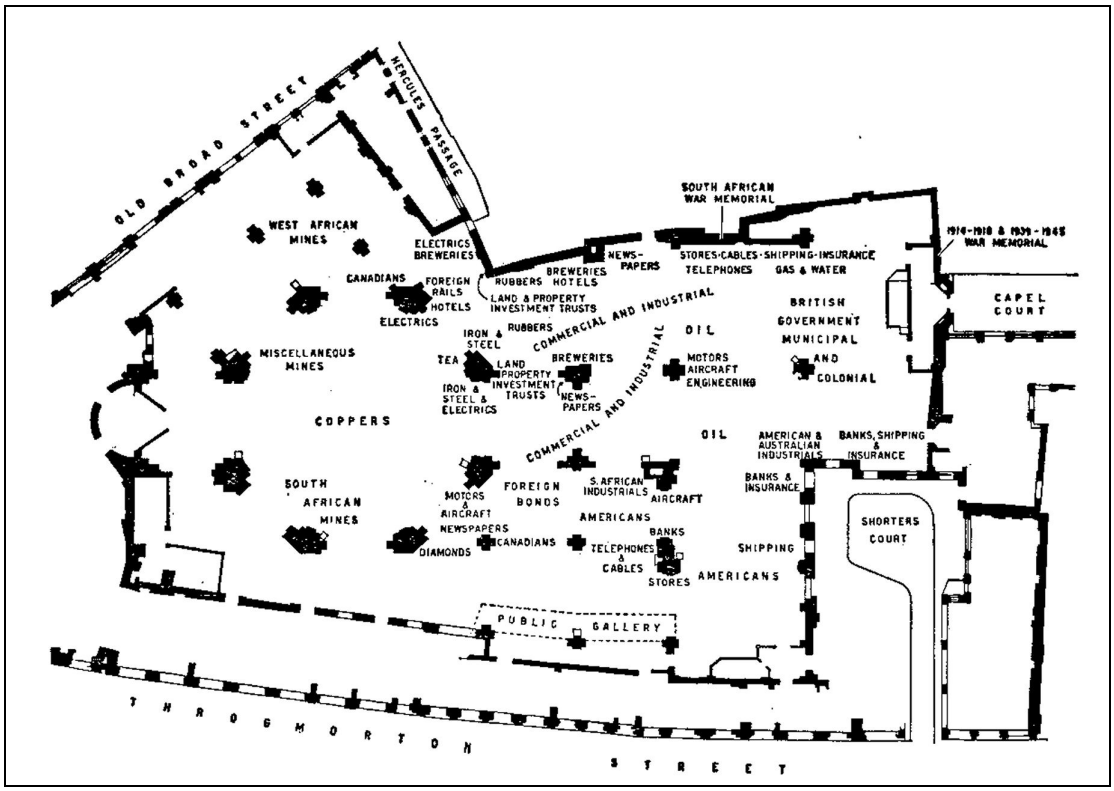


Figure 3.1 Distribution of jobbers on the trading floor of the London Stock Exchange c. 1968, as represented by (Hamilton, 1968)

In effect, it was through these rooms that liquidity entered the floor as orders were collected and passed onto the market for their execution in the hands of specialised dealers. It was this combination that created liquidity on the floor of the Stock Exchange, thus transforming the House into the source of prices that, as the securities they indexed, represented a great resource that required even greater controls.

Controlling the propagation of the prices generated on the floor of the House occurred through varying arrangements. The foremost was relatively simple and straightforward: access to the floor was granted only to members of the Stock Exchange, their clerks and the staff of a select group of newspaper and telegraph companies. Restrictions placed on the levels of physical access to the floor were supplemented by more overt regulations on the dissemination of prices. The Council of the Stock Exchange, for instance, introduced rules that obliged data providers to

delay the transmission of prices through telegraphs and prohibited member firms from distributing real-time quotes through the telephone. The strategic character of the floor and the prices therein generated was clear to both the Council and the membership of the Stock Exchange. Reporting in 1957 on the processing of company announcements on the floor, the *Stock Exchange Journal* noted that

> Accurate information is just as important in Stock Exchange practices as in any military operation. Without a flow of early comprehensive and authentic company news, jobbers are unable to assess values, brokers are unable properly to advise their clients, and investors are unable to form correct conclusions as to company prospects (F.S.G., 1957, p. 104).

Echoing later notions of markets as efficient informatic devices, the *Journal* proceeded:

> There are […] three major requirements which have to be observed [in collecting and disseminating company news]: (1) *Accuracy and authenticity* – that is, all the information must be issued and sponsored by the company concerned or come from some other responsible and approved source; (2) *Promptitude* – that is, the news must be placed at the disposal of the House immediately, it is available; and (3) *Impartiality* – that is to say, it must be available to *all* members or at least to all interested members simultaneously (F.S.G., 1957, p. 104).

Such interpretation of the trading floor vis-à-vis information persisted for some time, as made evident by subsequent political controversies that challenged the status of the Stock Exchange within the broader institutional arrangements of the City. In 1973, and reacting to claims made by a Working Group of the Labour Party Industrial Policy Sub-Committee, the Council presented a passionate argument for the floor as the natural and most effective niche of market information. Opposing the Working Group's view that information often took 'several days' to reach investors hence allowing for insider trading and other practices deemed undesirable, the Council wrote:

> The Stock Exchange [acknowledges] the reality that there is no way in which news can be received by all individuals simultaneously throughout the country. By requiring all company news to be published first at The Stock Exchange it insures that all Brokers have the information and are therefore able at least to prevent their clients acting in ignorance of it. Because the jobbers are also instantly apprised of the information and if necessary adjust the market price it is by definition impossible for any operator, however slick, to gain an advantage over any other once the news is published in the Market. Once an item of news has been announced the price in the Market at once

> reflects that news. If of course by whatever means the operator can anticipate the news this may be at the Jobber's expense and not at the small investor's (The Council of The Stock Exchange, 1974)

The purpose of the floor was thus to provide informatic equality to market participants through the proximity of jobbers, who made markets, and brokers, who acted as knowledgeable agents for investors. And being a confined space only accessible to members, the floor and its informatic contents were seen as controllable and manageable entities.

The physicality of the floor and the restrictions imposed on members and data providers were not the only means for stalling the dissemination of prices and other pieces of critical information outwith the walls of the Stock Exchange, however. The prime control of the communication of market prices resided in their genesis, which made immediate dissemination (and hence, the spatial bypassing of the floor) socially and technically impractical[5].

The impracticality of transmitting real-time prices lay in a longstanding division of economic and epistemic labour on the floor of the Stock Exchange, reinforced by the production of prices primarily as verbal utterances with a finite

---

[5] The strategic importance of controlling the dissemination of prices is highlighted by Kenneth Arrow's well-known observation on the economic properties attributed to information. As Arrow wrote (Arrow, 1959):

> In the absence of special legal protection, [an information vendor cannot] simply sell information in an open market. Any one purchaser can destroy his monopoly, since he can reproduce the information at little or no cost. […] With suitable legal measures, information may become an appropriable commodity. Then monopoly power can indeed be exerted. However, no amount of legal protection can make a thoroughly appropriable commodity of something so intangible as information. The very use of information in any productive way is bound to reveal it at least in part. [T]here is a fundamental paradox in the determination of demand for information; its value for the purchaser is not known until he knows the information, but then he has acquired it without cost (p. 9-10)

Due to the nature of the market offered by the Stock Exchange, the prices of the most actively traded shares were, in a sense, the 'best' available prices in Britain. Hence their immediate dissemination outwith the walls of the Stock Exchange (and outwith the membership) would have made it possible to altogether bypass the trading floor without incurring in the markup costs of limited liquidity. Clearly, bypassing the floor of the Stock Exchange entailed not only reductions in income for this organisation (fewer members implies less annual fees); this would also reduce the quality of the prices by driving liquidity to other trading venues, endangering the relative position of the Stock Exchange in the securities industry. It is hence not surprising to discover that as early as 1896, printed market quotations were protected by copyright law (T.L.H., 1917). Further discussions on stock exchanges and information ownership can be found in (Lee, 1999; Webb, 2003). A discussion of the emergence of news agencies and Arrow's paradox can be found in (Bakker, 2006).

reach. To some extent, this division of labour traced back to the origins of the British equities market in the late eighteenth century, when two types of professionals emerged – stockbrokers and stockjobbers – specialising in distinct, yet interrelated, activities. Stockbrokers, on the one hand, served as intermediaries between investors and the market. Stockjobbers, on the other hand, dealt on their own account, buying and selling shares and profiting from the differentials between bids and offers. Although this division existed informally throughout most of the nineteenth century, the authorities of the Stock Exchange enforced it in 1909 when large jobbing firms threatened the livelihood of brokers and small jobbers by dealing directly with investors through the telephone.. Effectively, as explored below, single capacity shaped not only the operation of dealing but, as importantly, the infrastructure of the marketplace.

A series of articles produced by former broker Donald Cobbett, who joined the Stock Exchange in 1933, provide a vivid picture of the physical and social environment that constituted life on the floor in the era of single capacity. In the early years of Cobbett's career, the floor was organised as a sea of brokers and clerks (referred to as 'blue buttons' due to the distinguishing pin on their lapels) dotted by jobbers and their pitches. Despite the patterns of spatial organisation that characterised the floor of the House, up to the 1950s the pitches or stands of jobbers 'were ambiguously notional, and not […] physically structural' (Cobbett, 1986). Similarly, lapel badges identifying members and dealers with their firms were only introduced in the 1960s. Indeed, the market was a maze in which jobbing firms

> […] assembled close around the walls and surrounding the massive pillars dividing the floor space irregularly into sections, had seating facilities, space to erect a price board, and improvised shelves for dealing books and other paraphernalia of the business. But a large number of jobbers not conveniently disposed, particularly the small firms such as the one I joined, were compelled to take their stand on the open floor, with the surging crowds of brokers and their clerks passing through and around them. (Cobbett, 1986, p. 22)

Forging interpersonal relations and keeping within the etiquette of face-to-face dealing on the floor was therefore a matter of critical import. Articulating a proper presentation was of such importance that expressive departures 'as suede shoes or a checky suit on a relaxed Saturday morning would bring down the displeasure of the

market on the individualist' (p. 30). Breaking the tacit conventionalities of the community, or simply not being entirely familiar with the identities of those on the floor, could prove to be a tremendous disadvantage when seeking to enter the market. 'The only information available to us in those days', wrote Cobbett (1986, p. 32),

> was gleaned from a perfunctory tour of the floor by the senior waiter, a medal-bedecked personage who would marshal each batch of new boys at the main door for a privileged insight into the layout, with the tacit expectation of a little something slipped into the receptive palm.

Being unaware of the conventionalities of behaviour on the floor resulted in the real impediment of not finding a friendly counterparty and a reasonable price.

3.2 Codes for the market

Within this decidedly tacit and intensely interpersonal arrangement, the creation of a market involved the production of prices upon which deals were made. On the trading floor, the prices of shares and bonds acquired the form of uttered quotes, of pairs of numbers that indicated the values at which jobbers were willing to buy and sell a security. In normal dealing conditions, these utterances were formed on the request of brokers. Price-seeking brokers would approach jobbers and vocalize their requests, saying something of the sort 'What are BP?' That is, in the conventions of the floor, brokers would verbally ask jobbers to provide a quote for shares in, say, British Petroleum. And under the *Rules and Regulations* of the Stock Exchange, the jobber was obliged to provide a quote. Upon a request, a jobber would reply with an utterance similar to 'five hundred to five' ('500-5'), indicating that the price at which he was willing to buy 'a reasonable' number of shares was 500 pence (bid) whilst the price at which he was willing to sell was 505 pence (ask). To his answer, the broker could follow one of several paths: he could agree to buy at a volume pre-indicated by the client (that is, to execute the deal) for which he would have to respond something like 'Take 500' (sell) or 'Take 505' (buy); he could mention that he is only quoting (that is, he was merely asked by the firm or the client to find out the price of a particular share and did not have an order to deal); or he could walk away to another pitch, searching for a better price. Taking any of these paths required the broker and the jobber to possess an understanding of the conventions on the proper modes of holding a conversation on the floor. Specific socially agreed codes on how one

should talk, built over years of institutional practice and standardisation, determined the existence of commitment, or lack thereof, between the parties involved. The operation of the Stock Exchange was thus close to the spirit of its motto: *Dictum Meum Pactum*, My Word is My Bond. Finance in London was, in effect, performed through conversational exchange[6].

The *Code of Dealing* of the Stock Exchange (The Stock Exchange, 1976) provides a window into the conversational and linguistic conventions that served to establish commitment on the floor of the Stock Exchange in the days of face-to-face dealing. In it, we can observe, for instance, that to avoid committing to a deal, a broker needed only to utter specific words in a particular way (adapted from The Stock Exchange, 1976, p. 13-15):

> 'What are XYZ?' Answer: '125-8'
>
> *Broker*: 'I am only quoting. What is the size of the market?
>
> *Jobber*: 'I will make that (i.e. 125-8) in 2,000'

By saying 'I am only quoting,' the broker insulated himself from dealing and showed that his intention was getting a sense of the state of the market. But the conversation could have gone elsewhere:

> 'What are XYZ? Answer: '125-8'
>
> *Broker*: 'Is there any way in 250?' [or, can you make a closer price one way for 250 shares]
>
> *Jobber*: 'I'll make you 126-8'

Here, a different path was taken, showing the desire to either buy or sell 250 shares. Had the broker accepted an exchange of ownership, and consequently generated a register of the movement of legal documents of different kinds, this sequence of utterances created, in effect, a market price for that particular lot of shares and its associated volume ('250') and time (the moment in which the broker inquired for a 'way' in 250). Yet this did not mean that more extended forms of communication could not take place. If the broker had an order to trade limited as to price and was not authorised to ask for the 'way', the standard phrases could be as follows:

> 'What are XYZ?' Answer: '125-8'

[6] On a discussion of conversational exchanges and their relation to the temporalization and structuring of finance, see (Knorr Cetina & Bruegger, 2002).

Broker: 'I am limited. I'm ½p out in 250'

Jobber: 'I could deal one way' [i.e. he could make either 125½-8 or 125-7½]

Broker [hoping for the one which will suit him]: 'Very well, you may open me'

Jobber: 'Give you ½p' [i.e. 125½]

Broker: 'Sorry, I'm a buyer at 127½'

In this instance, the quote faded into nothingness along with the words that comprised it. And with the end of the quote, with the broker leaving the pitch of the jobber, the price was not performed into existence; there was no market price to be found[7].

Such dependencies on the spatiality of voice reinforced the generation of quotes as an interpersonally mediated activity. Quotes were created in the context of a face-to-face interaction requiring careful calculations of the counterpart's social character. Quotes were not only 'bound to the circumstances and the situation, [to] how many shares you were long or short on the book, [to] how the rest of the firm [was] positioned' (Steen interview); they were also connected to a 'knowledge of people', hierarchies of trust, and the social ecology of the marketplace. And as a closed organisation, the Stock Exchange facilitated such social calculations: the club was, in a sense, built purposefully as a self-regulated status group. Variations existed amongst the membership, nevertheless, with some individuals and firms considered more trustworthy than others. All things equal, quotes generated on the floor would not be necessarily the same for different people from different firms. Partial evidence of the tailored character of quotes is visible in numerous anecdotes and recollections, as well as within the reference literature on finance in Britain. For example, in his frequently cited manual to the Stock Exchange, H. Berman insisted on trust as a prerequisite for jobber/broker interactions when he wrote that '[in] order to be able to

[7] This point is particularly important for the sociology of prices. A price is a market price only insofar a deal was struck at that particular price. Quotes produced in a conversation that does not result in a deal are consequently not market prices. On the floor of the London Stock Exchange, however, numerous jobbers would deal in the same share simultaneously, opening the possibility for several market prices to exist simultaneously. Furthermore, as discussed below, prices were inherently bound to the identities of the interlocutors in the conversational exchange: the spread in prices would be larger the lesser the jobber trusted the broker. Hence, the prices generated on the Stock Exchange reflected not only knowledge of a putative state of the market but, as importantly, knowledge of the precise circumstances of a conversational exchange.

deal well a broker must be known, trusted and liked by the jobbers and to acquire their trust he must play fair' (Berman, 1963, p. 19). If this metaphor of face-to-face dealings were pushed to an extreme, one could argue that the market prices produced by successful deals were, in a very tangible sense, incommensurable bits associated to interpersonal forms of knowledge.

Voice was not the only method for communicating prices within the floor of the Stock Exchange. Due to the calculative intensity of life in the House (during busy times jobbers had to produce prices constantly while brokers had to procure them continuously either for dealing or for relaying them to their offices), non-vocal props were incorporated to the market. The distributed forms of cognition (Hutchins, 1995) that developed around these props grew to involve both particular types of vocalisations as well as a range of inscription devices. Up to the early 1950s, these devices consisted primarily of 'printed price display boards [located in jobber's pitches] which required regular (almost daily) replacement' (Cobbett, 1986, p. 32). Cobbett speculates that wartime rationing, along with increased costs of printing, led firms to introduce Perspex boards on which the security titles were 'permanently printed or separately enslotted'. On these boards, jobbers and their clerks would enter overnight closing prices in black and use chinagraph pencils to record the succeeding movements of prices in blue (for increasing prices) or red (for decreasing ones) throughout the day.

For the brokers and jobbers who constituted the market, whiteboards became more than mere proxies of uttered prices; they were a sort of coordinative device for the market, exposing quotes and prices that would have otherwise been invisible for members located in other parts of the floor. Such use of the whiteboards is illustrated by the recollections of a jobber who worked with the firm Wedd Durlacher before Big Bang (Stuchfield interview). If someone approached the pitch and asked for a price in BP,

> obviously, you had to think what BP are now. And, you know, two minutes ago I was thinking they were 500 to 5. But actually, I can see someone on the pitch opposite in different companies, mining stocks or something like that, a different sector completely. They just put a little blue up on the board, and something else has happened, and actually, now I think they're 500 to 7

It was by means of this visuality, of guaranteeing that prices could exist beyond the scope of the trading pitch and of human voice, that whiteboards became strategic appendages.

Figure 3.2 Trading floor of the Stock Exchange c. 1968.
© Henry Grant Collection/Museum of London

Two further examples demonstrate the point. The first concerns cases in which a 'big' order arrived at the market. Given that jobbers worked with the spread between bids and offers, holding large inventories could be a problem. In order to 'unwind their positions' (for instance, to get rid of an excess of shares without affecting market prices in too big a fashion), it would not be uncommon for jobbers to be a 'bit reluctant to change their board prices, it may be that they've done a deal and don't want to broadcast [it] to the world' (Attard interviews). The second example relates to the careful 'manipulation' of the specific representations of the market by means of controlling the prices displayed on whiteboards. In order to conceal the nature of his transactions from his peers, a jobber noted that

> [one] might change the price [on the board], but it needn't necessarily be correct. Say, for example, you sold some shares at a £1, a lot of shares; well, in order to be clever you would mark the shares down to 19s 9d or something like that, you see, so that the other jobbers would think you probably bought the shares. So this was all part of the skilful back and forth play in the art of jobbing. (Attard interviews).

This strategic production of prices extended beyond the visual cues deployed amongst jobbers. Whiteboards also served as instruments for promoting and driving up the quotes of shares, as exemplified by an episode recalled by Nic Stuchfield. During the early 1980s, and while on vacation as a student at the University of Oxford, Stuchfield joined the team of one of London's leading jobbing firms to train on the floor of the Stock Exchange. Stuchfield was assigned to work on the Australian mining book, which consisted of a list of mining shares selected and managed by a senior partner. As part of his research, the senior partner travelled to Australia to inspect facilities, talk with managers and engineers, visit brokers in Sydney and Melbourne, and buy shares for the firm's inventory. On an occasion during which Stuchfield was on the pitch, the partner had returned from Australia, carrying shares of a newly found company. The market, as Stuchfield remembers, was 'a bit frothy', but generally the price of gold was 'really going through the roof'. Before the market opened at 9:30, the senior partner introduced his new finding to those in the pitch: 'Alright. I've got this company called GEM Exploration, which I've bought 250,000 shares of […] and I've bought them for the equivalent price of 3p. [We'll] see what we can do with them'. He wrote 'GEM' on the whiteboard and next to it he wrote '5' as the opening price for the share. Because it was written rather than printed on the board, it was clear for everyone in the market that this was a new share. And so, the first brokers were drawn to it. The first one to enquire about this strange new entry said 'I see… What's this GEM you've got up there? They look interesting. Tell me about that'. As the one responsible for managing Australian mining shares, the senior partner replied: 'Well, I went to Australia. I saw this company' and after explaining the business of the company, he mentioned he thought they were 'a real prospect in the current market conditions'. Intrigued, the broker asked for a quote. 'They're 4 6' replied the senior partner. 'What sized you'd like that?' asked the broker. '25,000' answered the jobber. 'OK, well, thanks very much.

I'll go away and have a think about that one' said the broker, walking away from the pitch. Regardless of the fact that he had not closed a deal, the senior partner changed the number on the board, writing in blue the number 6. The next broker approached the pitch, seeing GEM Exploration on the board.

> 'What are they this morning?' 'Ah, well they're 5 7'. 'What's the size?' 'Ah, well they're at bid for 25, offered in 10'. Which showed that I'm a buyer, obviously. And he said 'Oh, OK, well, I'll buy ten'. The next guy comes along and literally, within half an hour, the things are trading at 25p. By the end of the day, they're trading at 40p, and we've turned over 2.5 million and we are we are long 350,000 shares instead of 250,000 shares (Stuchfield interview).

In closing what was doubtlessly a successful day, the senior partner asked Stuchfield 'You know what, Nic? What does blue make?' to which Stuchfield answered, 'Blue makes buyers'.

As this vignette shows, despite their strategic role, whiteboards were ultimately subordinated to the utterances of senior jobbers and the logic of interpersonal knowledge on the trading floor. This subordination was evident in cases where whiteboards unintentionally contradicted the will of those managing the book. As a jobber reminiscing about his days as a clerk mentioned, updating prices on the whiteboard required time

> because as you were doing that so you were keeping an ear open for what your partner was doing if he was dealing. [Y]ou wanted to know what was going on, because quite clearly if he was doing a big deal there was going to be a change in price or what have you. One of these [brokers] would come up and say to you, 'What's the price of Welcome Gold', and you know, you'd suddenly shoot out a slightly old price and your partner might have heard and told you, 'No, they're not that at all, the price has changed' (Attard interviews)

In effect, whiteboards did not command the market. The prices displayed on them were by no means a pact with brokers on the floor. *Dictum meum pactum* extended only to utterances, not to their representations. And in a sense, whiteboards and other means of price visualisation did not occupy the same representational role as modern trading screens; they were not the same type of technologies. These were instruments, carefully woven into, but ultimately controlled by, the verbally-centred social practices of the floor.

3.3 Tying loose ends

As such, the materiality of market transactions relied on the verbality of finance. Such materiality, however, was not confined to the floor, overflowing the market beyond the granite walls, marble pillars, wooden floorboards, and plastic whiteboards of the Stock Exchange. Because shares are ultimately tied to the ownership of companies and debt, their exchange in the years before 'dematerialisation' required the production, modification and mobilisation of countless pieces of paper: certificates that stood as the legal instruments of ownership, registrars that informed firms about their equity structure, lists that allowed identifying whom to pay dividends and interest to, ledgers representing the inventory of shares and the portfolios of clients in jobbing and broking firms, notes confirming that particular securities were bought or sold from a specific jobber at a particular time and date, orders to buy shares at certain prices, and the different forms of tender used to cover a deal.

The management of these pieces of papers, so critical due to their economic and legal implications, was a gargantuan task. Each transaction on the floor produced a record (called a 'ticket'), and each of these records was verified manually for name, price and volume. At the end of the trading day, stockbroking clerks met to reconstruct the flow of market orders and to produce an image of how certificates and money should be re-distributed. Clerks in broking firms calculated the commissions and taxes associated with each trade in order to bill their customers. And with each transaction, companies updated their registrar, indicating who owned how many shares in the firm. Indeed, armies of couriers, clerks, accountants, and lawyers working to guarantee that the investors who bought and sold shares received their end of the bargain constantly rushed about the City of London. Settlement was the name of this game, and its end objective was to make effective the pacts created between jobbers and brokers, on behalf of investors, on the floor of the Stock Exchange.

Settlement of the most active shares in the market was located within the organisational and physical confines of the Stock Exchange. A Settlement Room was

originally provided for in the basement of the House in 1872 (Michie, 1999, p. 77), shortly after which a Settlement Department was formally added to the Stock Exchange's structure. The history of settlement, however, was not a smooth and continuous one. The department was closed for eight years as a result of the First World War, losing the 'skilled personnel that such operation required' (Michie, 1999, p. 291). With the outbreak of the Second World War, the suspension of fortnightly accounting periods and the introduction of cash bargains[8], work in the Settlement Department was once again suspended. It was not until January of 1947 that activities resumed at full pace, after gaining authorisation from the Treasury to reinstate account trading and after training a new generation of recruits on the intricacies of matching bargains.

In the post-war years, settlement became a critical factor in the development of the Stock Exchange as an institution. In particular, as mutualisation entered into force in 1947, the Stock Exchange came to provide a growing range of services, with settlement occupying a central role. With mutualisation, the complex ecology of the membership made almost tangible the politics of the organisation. Pressure grew from members to receive a higher degree of services at lower charges. But the views on how to achieve this varied. In the bear market that followed the war, settlement became a particularly controversial issue that exemplified the divergent views within the Stock Exchange. Large broking firms, equipped with greater numbers of skilled personnel and deeper pockets, could process their own bargains. Smaller firms, less equipped and more vulnerable to the sways of the market, could not. In the end, the Council of the Stock Exchange opted to subsidize the Settlement Department, used 'largely by the smaller member firms from the fees paid by all' (Michie, 1999, p. 334).

[8] The settlement of trades was bound to specific accounting periods. In the early twentieth century, these were fortnightly. All the trades that occurred within these periods had to be settled by a certain date. It was possible to carry on certain bargains into the next settlement period, thought this would not be the case for most of the trades. The purpose of this system was to guarantee the delivery of the certificates and cash that had exchanged hands by proxy on the trading floor. The introduction of the *cash bargain* during the Second World War, however, changed this system. A cash bargain involves the transfer of shares and certificates on the day following the trade. Extensive descriptions of the settlement process can be found in (Berman, 1963; Hamilton, 1968).

Despite the conflicts that emerged from the expansion of services following mutualisation, the reorganisation of the Stock Exchange illuminated the role of secondary services as competitive products vis-à-vis non-regulated inter-office markets[9]. An example of such services was a centralised system for the delivery and payment of registered shares, which became operational in August 1948, reducing the need of messengers carrying certificates between offices. The provision of these services required a careful political calculation. The Council could not alienate the membership by drastically increasing annual fees, yet it needed to expand its repertoire of services in order to avoid the potential fragmentation of the market. One solution found was to implement labour-reducing measures. In 1939, for instance, there were an estimated 13,646 people working in the City of London directly involved with the Stock Exchange, of which 726 were clerks in the Settlement Room. The number of workers indirectly involved with settlement was greater, however, for many others provided auxiliary functions in jobbing and broking firms as messengers, typists, account clerks and an increasing group of 'calculating-machine operators' (Michie, 1999, p. 298). In an attempt to control the costs associated to rising wages particularly amongst skilled workers, the Stock Exchange mechanised its back-office by acquiring a Hollerith punched-card machine in 1949.

The addition of punched-card equipment to the back-office was by no means limited to the Stock Exchange. During the 1950s, such systems became ubiquitous in both industry and government. In the City of London, however, trends in mechanisation were bound to the basic divisions of labour prevailing in the market. For stockbrokers, mechanisation followed from the installation of 'accounting typewriters—machines which combine the calculator and the typewriter, generally operating from one keyboard' (Day, 1956, p. 13). Although expensive (in 1956 they were estimated to cost up to £1,500, roughly £27,000 in 2008 prices), these machines offered an important advantage over existing forms of typing, allowing relatively junior staff to prepare a variety of records with cross castings and totals in one

[9] For instance, the emergence of institutional investors along with the decreasing cost of telephone communication threatened the role of the Stock Exchange, as they meant that large orders could be negotiated over the phone without passing through the minimum-commission system that was imposed on all the trades that took place on the floor.

operation. Stockjobbers, on the other hand, tended to adopt punched-card systems through which

> details of bargains are, as in the past, written in the Dealer's Book; calculations of amounts are made in the normal way; names of Companies and Brokers, &c., are translated into a figure code. Thereafter a routine operator with a desk keyboard instrument taps out the various figures and perforates a card; this is checked by passing through another desk instrument […] The cards accumulate up to some desired point in the operations and are then passed to the next operation. From this point onwards the machine takes charge (Day, 1956, p. 13).

Jobbers with such systems would obtain printed records covering most of their firm's requirements, accurately, legibly and in a fraction of the time otherwise needed.

The future, however, lay elsewhere. The possibility of performing complex calculations that previously required many staffed hours was seen as an obvious niche of office mechanisation. 'Calculations can to-day be done electronically', wrote Mark Day in the *Stock Exchange Journal* in 1956

> and as cogs and cams give place to transisters [*sic.*], magnetic cores and vacuum tubes, and electrical impulses become the order of the day, the question of the applicability of the Electronic Computor [*sic.*] to the Stock Exchange work is coming up for discussion and quite serious consideration.

Promissory images of mechanisation populated the minds of many in the Stock Exchange. Changing finance became a matter of changing its practices, of embracing automation and the distinct materialities that it implied.

> If only jobbers could be persuaded to report bargains into [a centralised machine] as they were carried out it would clear all stocks automatically and, not only that, it would give a running record of the dealing prices in every broker's office, reducing the staff required in boxes and order rooms and the House itself. […] We might even reduce the costs to such an extent that small orders became profitable and the ideal of the Cloth Cap Investor at last became a reality (Bennett, 1959).

Automation, it was preached, would not only usher an era of increased efficiency in back-office operations. Through the reduction of clearing costs and the streamlining of trade and settlement, it would also deliver, so argued its supporters, the long-held aspiration of a market in which even the orders from small, 'cloth cap', working class investors were profitable. It would transform the Stock Exchange into a centralised investment re-allocation mechanism servicing Britain at large.

In the early 1960s, mechanisation gathered pace. Investments in automated systems occurred both in the offices of member firms as in the buildings of the Stock Exchange. Between 1959 and 1961, the Stock Exchange furthered the mechanisation of settlement by leasing and installing an International Computers and Tabulators punched-card unit that could handle the automatic clearing of 140 stocks (Abacus, 1962) and up to 150,000 bargains in an account. In the same year, an article in the *Stock Exchange Journal* pondered about the possibility of introducing systems that would comprehensively cover the market. 'Some sort of computer installation in the Stock Exchange itself', read the article, 'could handle part, if not all, of the accounts and records at present kept in the offices of Members' (Anonymous, 1960b). The possibility of such a broad system of management led to an attempt by the Council of the Stock Exchange to index the market. The market was no longer the ocean of faces and relationships encountered by Daniel Cobbett in the 1930s. With a view to installing systems that could handle both accounting operations and valuation statistics, the Stock Exchange undertook a 'revision of the members' number code to bring it into line with the alphabetical order of firms and the devising of a Securities' Code' (Daedalus, 1960)[10].

The history of the introduction of computers to the Settlement Room of the Stock Exchange is not entirely clear. While a small number of member firms ventured into the realm of computing as early as the mid-1950s (the history of the mechanisation of broking and jobbing firms is explored in Chapter 5), the Stock Exchange was a notably slower adopter. Ranald Michie's comprehensive history of the Stock Exchange locates the purchase of the first computer, an IBM 360, in 1964 (Michie, 1999, p. 365). The new computer reduced a processing task to a tenth of the original 876 person-hours. Although the *Stock Exchange Journal* makes no allusion to this system, and although the records of IBM place the first purchase of one of their

[10] This development was similar to the re-formatting of the market that occurred in the American securities industry with the introduction of the stock ticker (see Preda, 2008). In London, however, the degree to which linguistic conventions changed as a result of items such as securities' codes was tangibly different from similar developments in Wall Street. The difference may well reside in the fact that these codes were primarily for the use in the back-office, rather than the marketplace, where linguistic conventions went largely unmodified.

systems (a Model 158) in 1973 (Grimm, 1977), computerisation was clearly well under way by the 1960s.

In March 1966, the Stock Exchange officially reported the installation of its first computer – an ICT 1903 – in the Settlement Office at 26 Austin Friars. An intriguing article accompanied the news of this acquisition. 'The bloodless technocrats', wrote Geraldine Keen, 'have found their way into this bastion of civilisation. The dustbins of Throgmorton Street will be loaded with quill pens and thousands of lines a minute will be clacking from the tasteful buff coloured peripherals of an ICT 1903' (Keen, 1966). The demise of a seemingly Dickensian past was not the only image marshalled by the new computer. Keen speculated that a central computer, perhaps more powerful than the ICT 1903 and backed-up by a standby copy, could eventually take over 'inter-member accounting, a large slice of client accounting, run an efficient up-to-the-minute prices and general information service, and possibly take over centrally the registration of all quoted stocks' (Keen, 1966). In the minds of some technophiles, a computer could thus become the locale of the market, perhaps the market itself. But such promise could only be achieved through a real-time, on-line, multi-programming system, which the ICT 1903 was not. The Stock Exchange's new computer, formally inaugurated by the Chairman on 1 November 1966, was limited to the settlement of the most actively traded shares, an activity that had been carried out with previous punch-card equipments. When the computer was initialized, reality proved to be modest in comparison to Keen's speculations. The first account fed into and entirely handled by the system was completed on November 15th. The processing of 170 stocks took a mere 12 minutes;

> the computer then took approximately an hour to sort the pieced bargains into order for printing and 25 minutes to print out the result. Under punched card methods, this work would have taken the Department, plus part time staff, approximately 12 hours on an Account of this size (Anonymous, 1966)

An incremental increase in efficiency, the new system was but a single step in a larger process of mechanisation that continued for decades to come.

3.4 A House for the future

The introduction of computers and punched-card equipment to the Settlement Room of the Stock Exchange was by no means the only type of innovation affecting the market's infrastructure. A series of seemingly pedestrian modifications of the *agencements*[11] (Callon, 1998) of the Stock Exchange took place along with the mechanisation of back-office operations. Such was the case of the patchwork-like building that housed the market in the years following 1945. Although many deemed fully adequate to the needs of a membership considerably larger than it was in the 1950s (Anonymous, 1955b), the ongoing reconstruction of the City of London inspired some to contemplate the erection of a 'really modern House, worthy of the great part we play in the affairs of the nation, and offering better accommodation and facilities to a larger number of our members' (Anonymous, 1955b)

The prospect of rebuilding the Stock Exchange had indeed surfaced as early as 1943. It was then that G. J. Buckingham, acting as Surveyor, produced the plans for a new house for the market. The realisation of these plans, however, proved problematic: after extended scrutiny by the Stock Exchange's Buildings Sub-Committee and the City of London Reconstruction Advisory Council, Buckingham's project was submitted to the City Corporation in 1948 from which he obtained conditional permission for development in 1949. Nevertheless, a 'number of difficulties and limitations' had to be surmounted before the first speck of concrete touched the ground. Constraints on the vertical height and surface coverage of the building made it of difficult design. But more importantly, any project of reconstruction would have to meet two qualifications imposed by the Sub-Committee: first, that the scheme should be economic, such that 'net income from tenants alone would suffice to service the cost of the entire rebuilding'; and second, that the business should continue to occur on the floor of the House during rebuilding. Although the former was an important obstacle to Buckingham's project (estimated to have cost between £3½ million and £4 million at a time when income

[11] The term *agencement*, which is used elsewhere in this volume, refers to the 'assemblages or arrangements—which are simultaneously human and nonhuman, social and technical, textual and material—from which action springs' (MacKenzie, Muniesa and Siu, 2007, p. 15).

from the fees paid by members amounted to roughly £210,000 per year), it was the latter condition which ultimately delayed rebuilding the Stock Exchange. After calling in G. A. Coombe for a second opinion and failing to identify an alternative venue for the market within the City of London (distance between offices of member firms and the floor of the Stock Exchange was, after all, a critical matter), the Committee indefinitely shelved its plan for the reconstruction of the House (Anonymous, 1955b).

It was only in the 1960s that rebuilding the Stock Exchange became, once again, a topic of serious consideration. In the years following mutualisation, the Stock Exchange expanded its sources of revenue – most importantly, through the introduction of quotation charges – closing the gap between income and expenditure. The relative financial stability provided by such charges allowed the Council to revive the long held ambition to rebuild, or at the very least refurbish, the House. In 1961, the decision to rebuild was announced to the members of the Stock Exchange. The cost of the new building was put at £4.9 million (£78.5 million in today's prices), although the plan included office space which could generate an income of £284,000 per annum (Michie, 1999, p. 450). As had been the case more than ten years earlier, the Stock Exchange set the condition that 'if it were to be practicable, [rebuilding] must take place on the existing site while the Market should also remain on that site' (Lord Ritchie of Dundee, 1963).

Fuelled by the affluence of the day, the Stock Exchange resolved the issue of the temporary floor by acquiring additional space through the freehold of the North British and Mercantile Insurance Co. Ltd. A similar strategy was followed with the offices of Messrs. Blydenstein and the Threadneedle Street Post Office. 'Our decision,' wrote then Chairman Lord Ritchie of Dundee, 'has been that we must pull down our existing home around our ears and build it up again while we stand, dusty but triumphant, amid the rubble. Things will not, of course, be as bad as that, thanks to the ingenuity of the architects, engineers and the contractors' (Lord Ritchie of Dundee, 1963). After arranging a complicated relocation of the Post Office and raising a £10m loan (Michie, 1999, p. 514), rebuilding of the Stock Exchange began.

The project proceeded at a steady pace, as reported by Colin Mansfield in 1967 (Mansfield, 1967). Demolition of the old building started in 1966. The plaster, timber and copper of the dome were stripped. The supporting steelwork was cut into pieces. The brick and masonry columns were brought down by explosives. And by January of the following year, the site was clear of the up to 17 feet thick concrete foundations dating from the nineteenth century. While a temporary trading floor remained on site, the contractors Trollope & Colls Ltd had to deal with the additional complication of the proximity of the London Underground tunnels that ran beneath Old Broad Street, from Bank to Liverpool Street. Concrete beams were laid along the site and next to the tunnels as a mechanism for stabilising the clay and avoiding unwanted movements. The use of a giant Archimedean screw to bore the 102 feet deep holes for the concrete beams proved to be invariably noisy. 'To claim that this is a quiet method' wrote Mansfield 'would provoke sharp protestations from those who have to work in the immediate environment'. Yet despite the noise, the crowds that filled the viewing gallery on Threadneedle Street, and numerous technical complications construction continued apace. Soon enough, a massive steel-reinforced concrete platform emerged on site, extending 40 feet below street level. Upon it, a core was built that supported the cantilevered floors, accommodated lifts, heating, and water ducts as well as other 'services'. And the walls, consisting of structural precast concrete units, provided the building with its face to the world. The new building, designed by Lord Llewelyn-Davies, eventually became a recognisable feature of the City's skyline. An ease on building restriction (which up to the 1950s had included that no building in central London could exceed 100 feet in height) and the control over a large area of the block, allowed for the vaulted structure that once stood on Threadneedle Street to be replaced by a 26 storey tower reflecting future visions of the nature of organisations. As Lord Llewelyn-Davies mentioned in the *Stock Exchange Journal*,

> Coupled with a controlled and consistent scheme of interior decoration and choice of furniture, the office worker today enjoys greatly superior conditions than in the past.
>
> Today there is a trend to much more mechanisation in office work, with the use of computers, punch card systems, pneumatic tubes and so on, and an increasing need for adaptability if organisations are to maintain their

> efficiency. There [are] also increasing standards for the general amenity and welfare of office workers and new office buildings answer these requirements in a way which old city buildings, however cleverly adapted, cannot hope to do.

And thus, in 1972, the House became the Tower, erected upon the imagined requirements of a modernised era. Hexagonal trading posts, equipped with telephones and television screens for the future, replaced the notional pitches of the old trading floor. The cavernous structure of the House gave way to a lighter, almost monochrome, space.

Figure 3.3 Traders on the floor, as seen from the visitors gallery c. 1980.
© Henry Grant Collection/Museum of London

The Tower represented a broader consolidation of the operations of the Stock Exchange. After all, it was a standardised, purpose-built venue for an increasingly far-reaching, institutional and mechanised marketplace. The consolidation also extended to the communications networks used by the members of the Stock Exchange. An important element of the rebuilding was the creation of a new Branch

Post Office and the room that would house the Private Automatic Branch Exchange, PABX (Mansfield, 1967). While the Post Office (that at the time controlled telephone communications in the United Kingdom) would serve as the link outwith the Stock Exchange, PABX would be the backbone of internal communications for brokers and jobbers.

The reconfigured communication system was conceived as the result of a comprehensive study on the past patterns of use and projected needs of the members of the Stock Exchange, an assessment that reflected the expanded offer of services provided to market participants. Rather than framing the 350 member firms as requiring individual facilities, the study concluded that it was necessary to treat the Exchange as a single community with a density of 14,000 telephones. The standardised system had to offer not only intercommunication between the offices, boxes and pitches of member firms, but also access to public exchanges, an internal telephone service for the staff of the Stock Exchange, and a speedy personnel location system (S.R.G, 1965). A manual system requiring 40 to 50 operators to keep the itemised accounting of calls would have cost some £60,000 per annum, in addition to the costs of equipment and accommodation. It was thus decided that an automatic installation with a central switch system was a better solution, not only because it provided the type and degree of interconnectivity desired by the Stock Exchange, but also because it represented substantial savings. A facility would provide both internal and external calls through single telephones. But while internal calls would be routed by the private automatic exchange, outside calls would take place through external exchanges managed in the switchboards of individual member firms. Overall, the PABX was planned to a capacity of up to 1,200 simultaneous calls to be connected. And the operating positions needed to handle the system could be reduced from 40 to a mere three, avoiding an administrative cost of some £56,000 per annum.

In addition to PABX, the Stock Exchange conducted studies on the feasibility of a personnel paging system. Plans were devised for a system specified to a transmission capacity of 600 location-calls every half-minute, in 2,000 different

channels corresponding to individual pocket receivers, and built with a call forwarding system for unmanned boxes. Supplementing the pocket pagers, a lamp indication system, based on a three digit code system, was also intended for installation (S.R.G, 1965). Although three manufacturers tendered for the provision of the paging system by 1965, the decision as to which system to implement was delayed by several years. It was not until February 1970 that a paging system developed by Modern Telephones Ltd., and boasted as 'the fastest and one of the largest at present in use in the world', was introduced to the Stock Exchange. In effect, the paging system was but one in a series of important changes: at the same time, brokers and jobbers were involved in a complicated move to a temporary trading floor in the Tower, and were dealing with the newly installed inter-dialing telephone service, re-branded STX (Anonymous, 1970a).

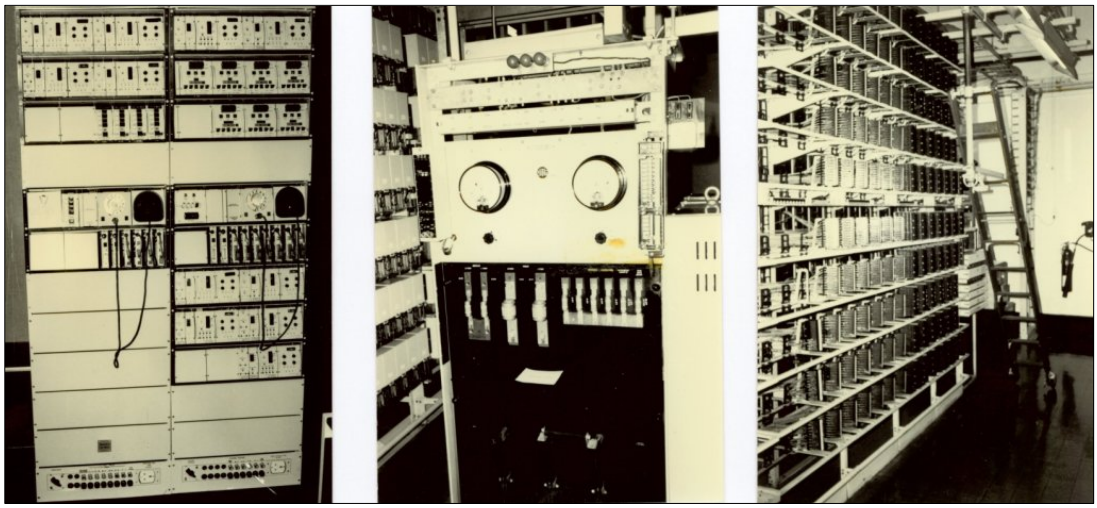


Figure 3.4 The STX Strowger-based PABX 1974, courtesy of John Scannell

3.5 The market on a screen

Throughout these reconfigurations, the commitment to face-to-face dealing remained constant in the Stock Exchange. Despite the mechanisation of back-office operations, investments in telephony, the possibilities offered by computerisation, and the modernization of the trading venue, the trading floor and the division given by single capacity were at no point challenged by either the authorities or the membership of the Stock Exchange. These were, in a very concrete sense, the core of the dominant form of finance-as-practice in the City of London.

Nevertheless, some of the broader technological developments of the post-war period ushered the possibility of automating one of the most critical aspects of dealing, that is, the communication and dissemination of quotes. In particular, reductions in both the costs and the technical challenges associated to the transmission of video signals implied that images of the whiteboards on the floor of the House could be taken to the offices of member firms. Effectively, as early as 1956, a small number of firms transmitted prices off the floor of the Exchange to television sets linked by a closed-circuit network[12]. The entirely analog system inherited some of the quirks of life on the floor of the House: prices were collected on an *ad hoc* basis, the clerks responsible for inputting quotes wrote these on a surface that was then scanned by a camera making them at times difficult to read; consequently, the images received in the offices of member firms were often of an inconsistent quality.

In the mid 1960s, the transmission of prices drew the attention of the Council as an area in which the Stock Exchange could intervene to become a central provider of information for the City of London's bonds and equities markets. After all, if price-display services were owned and operated by the Stock Exchange, the currency of the information displayed in them could be managed to disincentive the development of outside markets – mutualisation and the reorientation of the Stock Exchange towards the provision of multiple services were once again shaping the technological constitution of the market. It was in this spirit that the Council of the Stock Exchange pursued the development of an electronic mechanism for price and information communication. By early 1969, the *Stock Exchange Journal* announced that such system, named Market Price Display Service (MPDS), would be available by July of the same year. From the outset, MPDS was presented as being open to both member and non-member subscribers. And as such, it would not display real-time quotes. Rather, it was proposed as a display for the 'current middle prices of approximately 650 stocks on […] 16 main channels' (Anonymous, 1969b). Following the usage of the whiteboards located on the floor, the system was designed

[12] See, for instance, the images of the system displayed in the *Stock Exchange Journal*, Vol. 3, No. 1.

to show the closing price from the previous trading session and up to five changes in the mid-price for each stock. The blue and red chinagraph pencils from the floor, however, were not represented since MPDS worked on conventional black and white television sets. Two further channels were proposed featuring the prices of new issues, special stocks, currencies and commodities. And a remaining pair of channels would be used to broadcast company announcements and relevant pieces of information.

The initial deadline for MPDS was not met. In May 1969, the *Stock Exchange Journal* reported a new timeline for the introduction of the service, without committing specific dates. The completion of numerous tasks was required before the service went live. Television receivers had to be distributed amongst member firms; the General Post Office had to complete the installation of the coaxial cable distribution network within the City of London; the central control and processing equipment had to be delivered, programmed, and tested; input keyboards on the floor of the Stock Exchange had to be fitted; and a new type of clerk – the green-buttoned price collectors – had to be hired and trained (Anonymous, 1969a).

The ensuing development of MPDS occurred in a planned and careful fashion. Initially, the service operated on a restricted number of channels (16, solely for prices) and during a restricted period in the day (from 9:30 to 15:30). As testing and debugging continued, and as the suggestions from the users were compiled and analysed, both the number of channels and the time of operation of MPDS expanded. By the time the trading floor moved to the temporary space in the Tower in early 1970, nearly 1,000 MPDS television receivers were operating in 220 offices of member firms, the result of 70,000 hours of work by 250 external engineers (Anonymous, 1970a). In October of the same year, the service reached 145 member firms and 22 institutions, including press agencies, insurance companies, an arbitrage house and merchant banks, who were reportedly ‘very satisfied’ with the operation of the price and news announcement channels of MPDS (Anonymous, 1970b).

Allegedly, MPDS was the first system in the world to use a digital computer to feed information into slightly modified analog television receivers (Anonymous, 1970a)[13]. It was, quite probably, 'one of the first stock exchange display systems anywhere in the world' (Bennett interview) and one of the 'first cable networks' in Britain (McLelland, personal communication). Contested as these statements may be, MPDS was undoubtedly the first standardised computer-based price dissemination system available to the securities industry in the City of London. A Ferranti Argus 400, interfaced with an analog rotating video drum, produced the signal for MPDS. This particular design resulted from the cooperation between the computer manufacturer Ferranti and the Stock Exchange's Computer Services Group (Anonymous, 1970c). Ferranti had originally developed the Argus 400 in 1958 for the operation of the Bloodhound Missile MkII, but it became clear that the same system was useful in non-military applications requiring real-time control and communication.

The price information compiled by the Argus came from eight different terminals. Each of these dummy terminals consisted of a mechanical keyboard attached to a 12-inch monochrome Prowest monitor (Carey, personal communication). The price-input terminals were located on the periphery of the floor and their successful operation hinged on the work of a series of price collectors responsible for updating the system throughout the trading day. As was the case with jobbers, price collectors specialised in particular industrial sectors in order to make more efficient their traversing through a normally bustling and noisy trading floor. Each collector carried a slip of paper containing the names of 18 to 24 shares, next to which he or she could write their respective quotes at different times during the day. Slip in hand, a price collector would walk around the floor, obtaining the quotes necessary for completing the list from the main jobbers that made markets in those particular shares. Carrying the updated slip, the price collector would then go to the

[13] The television receivers installed in the offices of subscribers were VC100 television chasses supplied by Standard Telephone and Cables Ltd which had had the sound circuitry removed (Tony Carey, personal communication). However, it was perfectly feasible to connect any standard television receiver to MPDS. In fact, Peter Bennett suggests that one of the advantages of using a standard television receiver was that brokers could tune into cricket when the floor was closed (Bennett interview).

edge of the floor to enter the prices into the Argus 400 via one of the eight terminals, returning afterwards to the market for a new batch of prices. This cycle, which normally took between ten and fifteen minutes, was repeated throughout the day, hence making the prices on MPDS 'as fresh as possible' a guidance (McLelland interview). A system of safeguards, furthermore, guaranteed the accuracy of prices. When a collector inputted data into the system, the terminals displayed the new price underneath the old one. When she was sure that there was no mistake in the entered price, the collector pressed a switch that updated the information in the Argus, hence changing the price throughout MPDS. But if the change with respect to the previous price was too small or too great, the system required the collector an additional confirmation. And at all time, the supervisor of the price collectors could change the information on the system through her terminal (Anonymous, 1970c). A data entry terminal is shown in Figure 3.5.

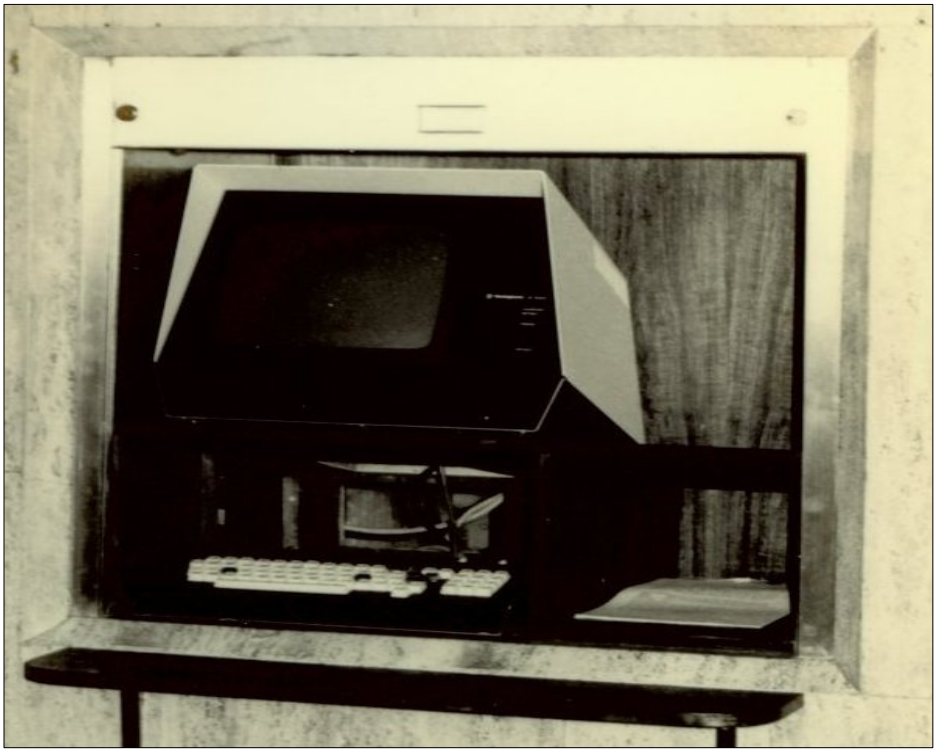


Figure 3.5 Data entry terminal for MPDS. Courtesy of John Scannell ©

MPDS was quickly embraced after its formal introduction in 1970. The television receivers displaying prices of the most active shares in the market expanded throughout the offices of firms in the City of London. Jobbers on the floor

quickly developed ‘pretty good’ relationships with price collectors, to such an extent that ‘they’d walk to them and almost as they were walking up they would quote them a price’ (McLelland interview). By relieving the blue-buttons from some of their work, MPDS left them ‘free to gather more specialised information. The new system has not rendered the old one obsolete but it has enabled it to be put to better use’ (Anonymous, 1970c). And as Margaret Hughes reported in the *Stock Exchange Journal*, ‘[in] little over a year the City’s brokers [became] a group of push button devotees’ (Hughes, 1971). These adaptations occurred despite the fact that the prices transmitted within the walls of the City were merely indicative; in all practical senses, they were not the stuff with which brokers traded, lacking both the requisite depth and the diversity of prices produced on the floor of the Stock Exchange. Users, however, were overall satisfied. Their comments on the service ranged from ‘rather good’ through to ‘very valuable and useful as an immediate indication of price movements’ (Hughes, 1971).

Although it did not affect the primary method of dealing – which remained limited to face-to-face encounters on the floor of the newly built Tower – the introduction of MPDS signified a quiet yet significant organisational metamorphosis. Having been partially funded with the income streams engineered after mutualisation, MPDS became itself a financial resource for the Stock Exchange. At the time of its introduction, every subscription to the service represented an annual fee of £500 for members and £1,000 for non-members (Hughes, 1971). Additional television receivers were charged at £50 each per annum, and as the marginal costs of installation were ‘next to nothing’ due to the relative simple technologies upon which MPDS was built (Bennett interview), every screen added to the system represented a profit – the cost of the equipment, after all, was covered by the subscribers. MPDS emerged from the outset as a business in its own right. And as such, the Stock Exchange considered that it was crucial for qualified in-house personnel to deal with the maintenance and further development of such a strategic asset. It was then that a new generation of technicians entered the ranks of the Stock Exchange, one that would prove fundamental in influencing the events in years to come.

3.6 Systems programming

If one were taken to select a moment that signalled the above-mentioned transformation, this could well be the hiring of Peter Bennett into the Stock Exchange. Arbitrary as this selection may seem, Bennett's career in the City of London reflected some of the general patterns that characterised not only the computerisation of British finance in the late 1960s and early 1970s but also the mobility of knowledge and expertise within the economic and technical communities of the City of London.

Peter Bennett's technical origins were broadly located within the complex institutional machinery forged in Britain as a result of the Second World War. In particular, Bennett (b. 1944) trained as a telecommunications engineer within Plessey Telecom Research ('an R&D establishment for the military') where he spent some time as a student apprentice. His formative years as an engineer also involved a five year sandwich course at the City University, London (formerly, the Northampton Institute; on the nature of these courses, see Teague, 1980), where he became acquainted with the use of computers. But as he mentioned, his formation there was not 'merely' academic.

> City itself was a very practical university. I had a wind tunnel. I had laser labs. All sorts of stuff. So I came out a bit of a boffin. But it was a wonderful environment. […] We had guest speakers from all over the world, top class speakers, Alan Turing, people like that. And, we had all sorts of clubs. We had something called the Math Lab which was an old wooden building which used to be used by the gardeners actually. It was an old gardening hut which had been refurbished, and in that was our computer. I had to go in this building and actually had to put on a white suit. And only very special people were allowed in. And there was an ICL mainframe, one of the first ICL mainframes.

Bennett was not the only one with such an institutional provenance. At the time, City University presented itself as 'a meeting place of financial and industrial minds', emphasising that its students were in close touch with computer science as with recognised techniques 'such [as] operational research or managerial economics' (Shone, 1968).

Bennett joined the Stock Exchange in 1971, attracted not so much by a pre-existing affinity to finance but rather by the fact that the position to which he applied for offered an attractive salary of £5,000 per annum, almost twice as much as what he was earning at the time. After several rounds of interviews, and receiving a bad report because of the flowery tie he wore (he would not 'fit in', read his personnel record), Bennett was hired. Although he could see that the Stock Exchange was interested in the possibilities offered by computing, Bennett remembers his arrival as one into an organisation that knew little of how to harness computers for use in data processing and dissemination. The ICL mainframe recently bought by the Exchange 'was doing nothing, just standing in the computer room'.

> The people who had been charged with [automating some of the back-office work] were the Property and Maintenance people, so [they] were […] actually in charge of lifts and escalators, and the plumbing and all that sort of stuff, and knew nothing about computers. And to cut a long story short, they spent a lot of money on this machine, and conveyor belts and stuff like that. [It was as if the system had been designed] by someone who'd worked at Ford Dagenham, because their idea of automation was to shift the paper from one end of the building to the other on a conveyor belt. And this mainframe, all it did was basically, sort of very basic process control (Bennett interview)

Bennett was the 'data bloke' brought in to 'sort all this out'. And indeed, he became an entrepreneur, carving a niche distinct from the existing computer and telecommunications groups at the Stock Exchange.

The project where Bennett initiated his career in the Stock Exchange was not directly related to the development of price information systems, although he was apparently involved in MPDS at an early stage of his career. When Bennett was hired by the Stock Exchange, settlement was once again under review. Between 1969 and 1970, the Stock Exchange sought to update its systems through the introduction of Bargain Accounting[14]. If bargains checking were automated through the introduction

[14] As reported in the *Stock Exchange Journal*, plans to modernize settlement were considered as early as 1960 when a City committee analysed the problems of the existing methods as well as the possibilities available to the Stock Exchange, including the creation of a nominee company. In 1966, after the passing of the 1963 Stock Transfer Act, a Stock Exchange sub-committee examined the opportunities offered by the use of a centralised computer system that avoided the production of tickets. By the late 1960s, the problems associated with settlement, and the possible advantages of using computers to streamline the process were clear: the London Stock Exchange had followed closely the problems faced by the so-called 'paper-work jam' of Wall Street in 1968 (Vice, 1968; Wells, 2000). This proposal of the sub-committee was hence taken seriously, ultimately informing the

of computers and with the addition of terminals installed in the offices of member firms, the number of errors could be reduced substantially along with the overall costs of the complete trade cycle. This required improved telecommunications between the floor, the offices of member firms, and the settlement room, an area in which Bennett's expertise could prove fruitful[15].

Initially, the existing staff of the Stock Exchange managed the expansion of electro-mechanical and computer systems for settlement. However, by the early 1970s, Stock Exchange leadership realised the need for external expertise if the project were to materialise. Michael Jenkins, a management consultant who had experience in the development of reservation systems for the British Overseas Airways Corporation, was hired in 1971 as a technical director to analyse the development of the new system. And in hiring Jenkins, the Stock Exchange created a new organisational branch, the Directorate of Information Systems and Settlement, which would take care of the computerisation of settlement in the following years (Jenkins, 1974) (Jenkins eventually became technical director of DISS). Soon enough, Jenkins realised that Bargain Accounting as proposed would prove costly and ineffective – the 'fairly grandiose computer scheme' would become a disaster. He recommended the Stock Exchange to stop investing in the project. But, since a change in settlement was needed due to increased trading volumes, the project was re-structured. The team headed by Jenkins proposed a new settlement system based on the findings of a report published in 1970 by a City Working Party on Securities Handling. Named TALISMAN, for Transfer Accounting and Lodgement for Investors, Stock MANagement for jobbers, the settlement system would make unnecessary the use of tickets to settle bargains, effectively reducing the paperwork associated to matching deals, clearing securities, and updating company registrars. But as the complete elimination of tickets was too ambitious a project to be carried out in a

---

deliberations of the City Working Party on Securities Handling, chaired by the Chief Accountant of the Bank of England, R E Heasman (Jenkins, 1974). The report of this committee, as is described in the following paragraphs, set the guidelines for the computerisation of settlement in the London Stock Exchange.

[15] The development of settlement systems and of the hardware and software upon which they relied was carried out by a section independent of the Communications Department and the Computer Services Group.

single step, an intermediate system was designed that relied on the existing method. Named CHARM for CHecking, Accounting and Reporting for Member Firms, the intermediate system was introduced in the first half of 1970 and formed part of a larger, multi-phased project for the automation of post-trade accounting, settlement and clearing.

CHARM itself consisted of two phases. The trade magazine *DataSystems* reported the first, a checking system, as superseding 'the traditional method of checking bargains whereby Brokers and Jobbers, having dealt on the Floor of The Stock Exchange, prepared lists of bargains to be checked manually the next day at Blossoms Inn'.

> [E]very day about 300 staff went down to the Checking Room and called over the bargains dealt the previous day. In many ways the Checking room was like a second trading floor – on average 20% of the bargains did not match exactly and staff had to agree changes on the spot. […] Many alterations […] are made in the Checking Room but there is a small residue of bargains that cannot be agreed on the spot. These have more serious errors and must be referred back to the dealers and then checked over the phone. […] A checked bargain is the starting point for the settlement process and to ensure accuracy the Council decided that this matching of bargains should be done by computer (Anonymous, 1974).

Unlike the prevailing arrangement, where data-entry was physically centralised and required the work of numerous clerks, the checking system that part of CHARM allowed each firm to report bargain details directly into a central computer. Larger firms possessing computerised management systems of their own could enter the information of the bargains made throughout the day by sending their magnetic tapes and punch cards directly to the Stock Exchange Computer Centre on Wilson Street. But there remained many firms that could not invest in computing. For these, Bennett thought, the equivalent of a banking terminal could be installed in their offices and connected directly to the Stock Exchange's dedicated IBM 370/145 (it seems that the first computer used for matching bargains was an ICL mainframe; Bennett interview). Bennett deemed such terminals the basis of a larger remote data entry system, providing both input and output facilities that could handle the daily capture of deals as well as the production of printed reports of previous trading sessions.

The choice of terminals became the entry point for other technologists. At the time of the development of CHARM, Olivetti was expanding into the market for terminals and minicomputers, both of which were being adopted within banking and finance. Olivetti, for instance, was involved in the installation of an electronic check clearing mechanism at Barclay's Bank. Holding great similarities to the settlement of deals in the Stock Exchange, check clearing was a very manual activity.

> If you wrote a check, it would go to the banking office and a girl would key in the details into a machine which would a punch card and that would be loaded on the IBM system, because that's all they had in those days (Scannell interview).

The introduction of magnetic ink character recognition in United States banking during the mid 1960s made possible automating most of these processes. Indeed, the Inter-Bank Computer Bureau, formed by a series of British commercial banks, implemented character recognition as a standard in 1970 (Inter-Bank Computer Bureau, Bank of England, C156/1).

Automated check clearing, however, was not entirely fault-proof. There would always be checks on which the E13B number was damaged to the point of making them illegible to the machines, thus requiring 'about 40 girls who were in an office with these punching machines taking the checks that wouldn't go into the scanner, keying it all in into the punch card, [and] loading the punch card into the IBM. Horrendous process' (Scannell interview). The solution implemented for this arrangement consisted in adopting minicomputers. The system installed by Olivetti in Barclay's Clearing Department in 1971 connected dumb banking terminals to minicomputers.

> A girl was to get the check. [She] would key the details into the banking terminal. [That] would simply write it on to a tape, and the tape would be taken off the minicomputer [and] loaded straight into the IBM. So we it cut the number of staff required significantly. And that was successful (Scannell interview).

News of Olivetti's terminals and minicomputers eventually reached the London Stock Exchange. The Olivetti TE 339 terminal, in particular, was seen as a solution for the technical specifications of CHARM. John Scannell (b. 1944), who joined Olivetti in 1964 as a field engineer and was a section manager by 1970,

> ended up doing a presentation to Peter [Bennett] and a few people of the Stock Exchange when I was working [for] Olivetti to [explain] how we would support [the terminals], because I was running the support operation for it, and I immediately got on quite well with Peter (Scannell interview).

The purchase of 150 Olivetti terminals for CHARM created a relationship between Scannell and the technical teams of the Stock Exchange. When Olivetti closed its branch in the City of London, making Scannell redundant, he sought refuge at the Stock Exchange. 'Within a couple of weeks I ended up working for Peter […], because they'd bought the Olivetti banking terminals' (Scannell interview).

CHARM symbolised an important element of the computing and engineering cultures of the Stock Exchange. From the outset, Bennett formed the team that implemented the communications network of the new settlement system around systems programming, with design preferences biased towards developing applications and systems from scratch as opposed to purchasing and installing ready-made solutions. This was visible in the design choices made by Bennett's team around the validation of bargains. Before passing bargains to the IBM 370/145 for checking, the data required a filter to detect input errors. Minicomputers could handle this step of the process. And Olivetti, with whom Bennett had developed a relationship through Scannell, provided such minicomputers. Nevertheless, '[t]hey didn't buy the minicomputer. They bought a [PDP-11/40] minicomputer instead because […] they wanted to write the application on that themselves' (Scannell interview).

As Bennett's team grew, similar views became increasingly frequent. Computing systems such as those provided by IBM were deemed 'too hierarchical' in comparison to the more 'flexible', more 'open' alternatives given by vendors such as Ferranti, developers of the Argus 400 on which MPDS relied, and Digital Equipment Corporation, developers of the PDP-11s on which the data validation mechanism of CHARM was based (Newman, personal communication). The prominence of systems programmers subsisted even beyond the transformations of the 1980s. Simon Peter Buck, who joined the Stock Exchange in 1979 after completing a degree in computer science at Imperial College, London, recalls

> In those days there was this big sort of distinction between systems programmers and application programmers. And it was like the distinction between us and [settlement] guys. The [settlement] guys were applications programmers. Application programmers wrote COBOL programmes and didn't really understand computers. They just strung a few instructions together, put some numbers in at the front and they came out at the end and that was it. And the fact that it was running on a computer was largely irrelevant. Whereas systems programmers had to actually understand how the computer worked because you were working at the level where you were fundamentally using the structure of the computer to do things. […] That was very much a sort of system programming sort of approach to things. […] Although obviously we were writing applications it was very much more bound into the system (Buck interview).

The rift between Bennett and the settlement team emerged, as Buck suggests, from a difference in computing cultures. Even at the time of its creation, Bennett considered the design of the central settlement system arcane.

> Why not go for a real-time settlement? You know, why go through this stupid batch processing? They did it because they had an ICL mainframe which was going to spare. And, you know, at the time, there weren't that many computers that could not only check, but that could actually [offer] real time checking and real time reporting. But that was too far for these guys at this stage. So I just basically stayed back and did my bit on the telecom front.

From this point onward, settlement and telecommunications would follow different paths. They remained disconnected and showed, each in its own way, the tensions between the complex and at times divergent interests of the member firms of the Stock Exchange and the distinct technical cultures of its employees[16].

[16] Unlike the dissemination of prices, settlement presented numerous legal complications to the securities industry in Britain. The development of TALISMAN, for instance, required changing the law of ownerships of shares as to allow for the creation of a transfer intermediary known as the Stock Exchange Pool Nominee, SEPON introduced). SEPON effectively held the stock between accounting periods (which at the time were fortnightly), allowing their free transfer between brokers and jobbers. The system devised for TALISMAN proved to be tremendously effective. It was not until the late 1980s that the Stock Exchange embarked on the development of a replacement for TALISMAN which came to be known as TAURUS (Transfer and Automated Registration of Uncertified Stock). Part of the rationale behind TAURUS was the reduction of the account period from two weeks to three days. Likewise, it was seen as an opportunity to 'dematerialise' shares (namely, to altogether eliminate paper certificates). TAURUS, however, became a project fraught with political and technical complications. The project was halted in 1992, after expenses for £100 million, and led the Bank of England to intervene. The Bank of England eventually introduced its own system, CREST, in 1994. Incidentally, the design for CREST originated from the gilt-settlement system introduced in the Stock Exchange in the 1980s, which was developed by a team of which Bennett was part. The general history of settlement in the Stock Exchange is captured by (Michie, 1999) while the case of TAURUS is analysed in (Drummond, 1996).

3.7 MPDS goes to the country

In 1973, the structure of the securities industry was altered, testing the technical infrastructure of the London Stock Exchange. It was in this year that the stock exchanges of the British Isles amalgamated to create a unified institution, the Stock Exchange of Great Britain and Ireland.

The idea of a single organisation covering all brokers and jobbers in Britain had existed in numerous forms since the early twentieth century. However, it was entertained with particular force in 1962, when a London-based committee investigated the possibility of creating a national stock exchange for the whole of Great Britain. As a result of the committee's deliberations, the Federation of Stock Exchanges in Great Britain and Ireland was established in 1965. The Council of the London Stock Exchange saw membership of the Federation as but a single step in a larger process of unification.

The London Stock Exchange expected to use the Federation to eliminate dealings in dual capacity in other stock exchanges in the United Kingdom thereby taking the principles of their organisational structure to every corner of Britain. The Federation, nevertheless, was not a trivial battlefield and became the site of a critical defeat. While it did not outlaw dual capacity amongst provincial jobbers, the Federation restricted London brokers from accessing regional securities markets (Michie, 1999). Full unification became the only means to deal with the fragmentation of the market and the competition from non-member brokers, especially as reduced costs in telecommunications made matching bargains over distance increasingly affordable. With the political support of its largest broking and jobbing member firms, the Council of the London Stock Exchange pursued unification throughout the late 1960s and early 1970s. The threat of competition from foreign securities houses that dealt in domestic shares, however, catalysed the national debate and set the stage for a nation-wide merger.

The merger of the London Stock Exchange with the provincial exchanges[17] transformed London into the undeniable pole of influence of the securities market. But it also presented the organisation with a series of technical challenges. In particular, amalgamation implied guaranteeing equal access to the services provided in London to peers in the provinces. For settlement, this entailed extending the remote data entry system devised for CHARM and TALISMAN to the offices of provincial brokers and jobbers; and for market services, it meant taking the signals from MPDS had to the regional centres across the United Kingdom (Newman interview).

MPDS posed a particularly important technical challenge. The original design of the service relied on a coaxial distribution network, and the London Stock Exchange could not just link the regional centres by plugging them to the existing infrastructure (Newman interview). The cost of installing hundreds of kilometres of coaxial cable between the City of London and the regional centres (located as far as Birmingham, Glasgow, Liverpool, Dublin and Belfast) was prohibitive.

The solution devised by the Stock Exchange made use of the same type of technologies introduced for CHARM. The system created for the new unified institutional arrangement received the name of Country Market Price Display Service, cMPDS. Relying on the existing infrastructure of MPDS in London, cMPDS involved installing a PDP 11/40 in each of the regional centres across the United Kingdom. Each of these PDP 11/40s received a digital feed produced by the Ferranti Argus 400 at the London Stock Exchange (McLelland interview) through a dedicated telephone line. At the end of the network, the PDP 11/40s created simulated televisions by requesting information to the computer in London. Thus, the service delivered to the country was digital in constitution but provided the same visual representation of the market as the analog television receivers in London

[17] Although dominant, London was not the only financial centre in Britain. Since 1836, it had shared the market for British securities with exchanges in Birmingham, Manchester, Liverpool, Cardiff, Bristol and Glasgow among others. Provincial stock exchanges, however, tended to specialize in raising capital for, and trading shares in, regional companies. On this, see Thomas (1973).

> So [you had] a sort of hybrid. In the centres, [you had] the television cable we'd done, but people weren't actually all living in the centres, so they got the slower version which [was] purely digital. [We] made [..] it look back to being analog television whereas it wasn't. This was in order to create a so-called fairness with everybody seeing the same thing (Newman interview).

Country MPDS proved a milestone in the technological history of the London Stock Exchange. At one level, cMPDS signalled an organisational change in the production of new computing and telecommunication systems. Up to the introduction of cMPDS in 1974/75, technological developments within the Stock Exchange were produced through outsourcing. Indeed, while MPDS emerged from collaboration with Ferranti, cMPDS involved the information technology provider Logica (McLelland interview), which was behind the messaging system of the Society for Worldwide Interbank Financial Telecommunication, SWIFT.

But cMPDS would be the last major project to be outsourced. Rather than leaving the job to external vendors and service providers, the technical staff of the Stock Exchange started to expand rapidly, hiring and retaining individuals whose expertise were deemed particularly valuable. Such was the case of Ian McLelland, an electrical engineer trained at Swansea University who joined Logica in 1973. Some years after having worked for Logica on the development of cMPDS, the Stock Exchange took McLelland up for the development of other projects (McLelland interview). The debugging of cMPDS provided itself an entry point for increasing numbers of qualified personnel and the growth of the Stock Exchange's technical teams. Country MPDS was not free of problems. Michael Newman, who eventually became a key figure of the Stock Exchange's information systems team, joined precisely to manage what had become a messy arrangement.

> When I joined, [the cMPDS project] was in a mess. [The] number of errors and faults had risen faster than our ability to solve them. So every time we thought we'd solved three problems and put a new release out, another seven would appear. So one of my first projects was to get control of […] Country MPDS and bring some discipline to solving the problems (Newman interview).

A consequence of this growth, born out of the necessity to expand and maintain the Stock Exchange's systems, was to bolster the position of Peter Bennett within the organisation. In effect, both Newman and McLelland became close collaborators of

Bennett, whose ideas were increasingly influential in the technological decisions taken by the Exchange.

At a different level, the introduction on CMPDS unveiled the potentialities of digitalisation and, in particular, of digital transmission feeds. Contrary to the service provided in London, CMPDS was digital at its core – it was precisely this digital character that allowed relaying data from the London floor across the country. Although it preserved the visual formatting of its analog predecessor, CMPDS showed that digital technologies could accomplish more with less: they could expand throughout the United Kingdom, perhaps even abroad; they could provide the same quality of information, if not better; and they could be adapted to the needs of individual users with relative ease.

3.8 The dangers of digital

The consolidation of the Stock Exchange's systems, represented by the developments in both settlement and price communication, could not have come at a better time. After all, the technologies upon which the Stock Exchange built its many services were increasingly available in the market. Any institution willing to invest adequate sums and to pursue the creation of systems catering to the needs of the securities industry could become a direct competitor of the Stock Exchange. It was only a matter of time before someone used digital technologies to tackle the monopolistic position of the increasingly digital Stock Exchange of Great Britain and Ireland.

Competition came in 1971. On that year, institutional investors mounted a unified front against the Stock Exchange, whose fixed-commissions system they considered uncompetitive[18]. The Accepting Houses Committee, a select group of

[18] Strongly capitalised and increasingly diversified, merchant banks in the 1970s did not have access to the floor of the Stock Exchange. They could neither own broking firms nor become members of the Exchange. During the late 1960s, early 1970s, the merchant banks sought to negotiate a deal with the Stock Exchange through which they would receive discounts on commissions, bypassing the retail market on the floor. The merchant banks, along with other large institutional investors heavily involved in the market,

> did not see the need for the broker's research, since they had their own staff of fund managers and analysts. And as, increasingly, they wanted to buy large parcels of stock, they,

merchant banks, struck the first blow. In May of 1972, the Issuing Houses Association (formed by members of the Accepting Houses) announced that a group of merchant banks would embark on the creation of a computerised dealing system named Automated Real-time Investments Exchange, ARIEL, providing 'an inexpensive efficient trading market which will transcend National boundaries' (Kynaston, 2002). The seventeen merchant banks that initially subscribed to ARIEL found inspiration in the United States. In particular, the model for ARIEL was the block-trading system pioneered by Instinet in 1968/9 (Littlewood, 1998). As such, ARIEL departed from the methods of dealing long held in the London market. ARIEL guaranteed complete anonymity, breaking with a face-to-face dealing tradition that spanned more than a century. ARIEL was open to all institutions, departing from the club-like character of the Stock Exchange. ARIEL disintermediated trades, eliminating the division between market-makers and brokers hence challenging the system of single-capacity that defined the structure and operation of the Stock Exchange. And even in terms of technological cultures, ARIEL was a patented system, whereas the services developed at the Stock Exchange were not (as Peter Buck mentioned in interview referring to the patenting of the Stock Exchange's systems, 'people just didn't think like that. You just got on and did things'). The system, set for introduction in 1974, was planned to secure 10% of the institutional business, equivalent to 4% of the total equity market (Littlewood, 1998).

The Stock Exchange was quick to perceive the threat posed by ARIEL. Its first reaction was regulatory, prohibiting its members from joining the system. A statement of the Council issued in 1973 captured the rationale behind the decision. ARIEL, said the council, was 'incompatible with the established methods of dealing in securities in this country' (Council of the Stock Exchange, 1973). By ignoring the separation of functions that defined securities dealings in London, they argued, ARIEL would jeopardize the fairness of the market. The fragmentation entailed by the

---

> or rather their brokers, found the jobbers hard-pressed to find it from their own books and even less willing to take a big risk with the price (Chapman, 1988a; p. 43).

As noted by Kynaston (2002), what drove the merchant banks to develop ARIEL was not so much the Stock Exchange's fixed-commissions but rather they were not granted a privileged exception, a possibility that was out of the question for the Council of the Stock Exchange.

system, furthermore, would 'reduce the effective establishment of fair prices'. And finally yet importantly, ARIEL posed potentially grave problems of supervision:

> [what] 'ARIEL' seeks is direct access to the jobbing market without accepting the disciplines which are imposed on the members of the Stock Exchange in the interests of the whole securities industry.

The Council of the Stock Exchange also leaned on the most prominent financial information provider at the time, Exchange Telegraph Co. (Extel), to guarantee that up-to-date prices from the floor would not be available to the competing system. They organised fact-finding missions to the United States, where they assessed the operation of the three existing computer-based systems (e.g. Instinet, Autex and NASDAQ[19]). And, critically, they pressed for the development of instruments that would obtain

> the maximum advantage in the distribution of dealing information to institutions [by introducing] a system which instantly recorded prices at which deals took place and a further communication system through which brokers could inform institutions of their interest in lines of stock (Hamilton, 1986, p. 5).

To an extent, ARIEL catalysed technological innovation within the Exchange. Specifically, it created an organisational rationale for the creation of the systems that would become central to the Stock Exchange's approach towards Big Bang more than a decade later.

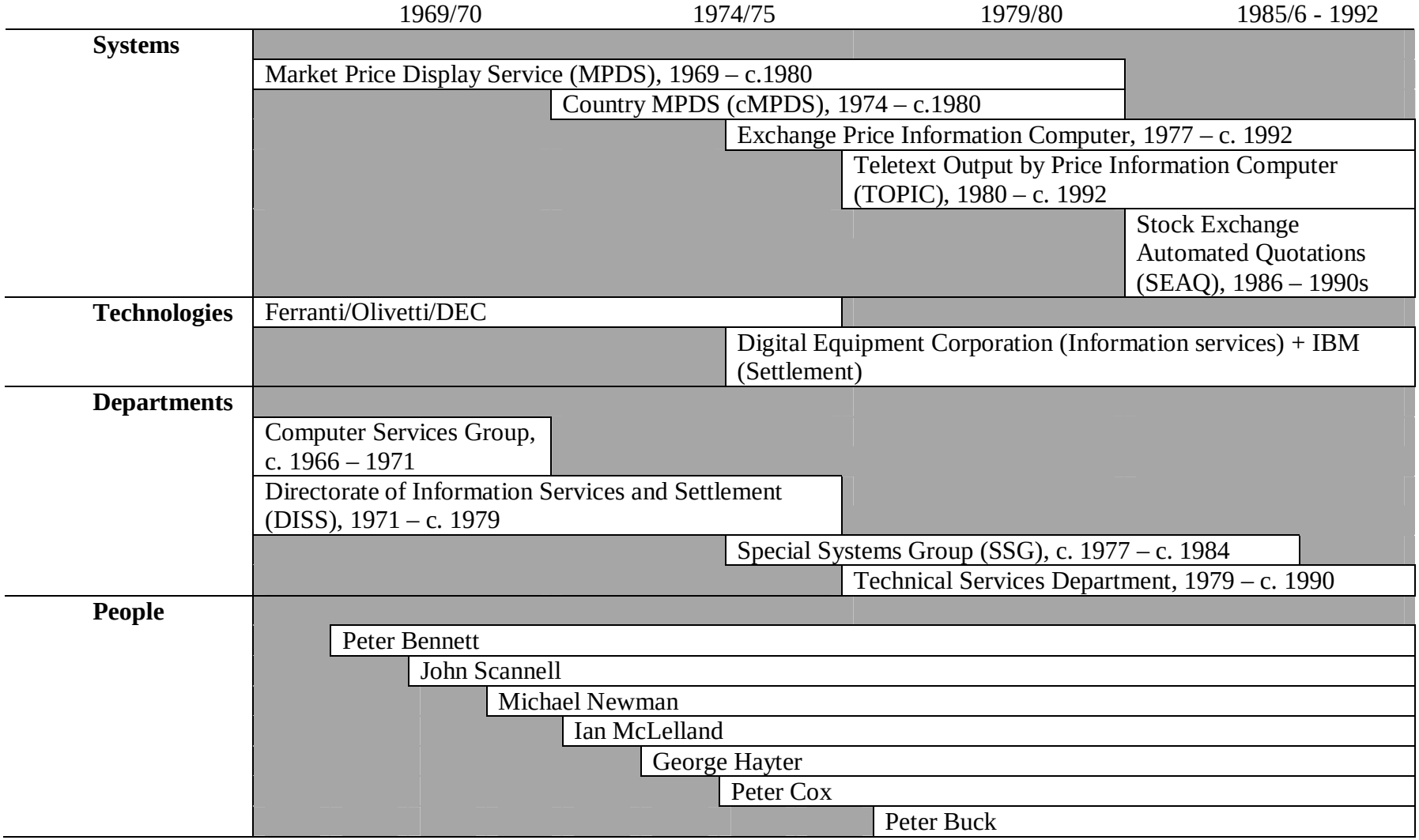
The risk posed by the new system faded away rapidly, however. After its launch in 1974, ARIEL underperformed its original expectations, capturing only one per cent of the jobber's total share and two per cent of the institutional business (Davis, 1979). The explanations for the demise of ARIEL are numerous. The year of ARIEL's introduction saw a steep fall in the market, reducing overall stockbroking activity (Littlewood, 1998). Although the Bank of England never openly opposed ARIEL, it did not allow the inclusion of gilts (a tradable UK government debt) in the

[19] Such missions were important in presenting existing technological possibilities to the Council and membership of the Stock Exchange. At a later point in time, for instance, the Stock Exchange assessed the possibility of developing a system similar to the one provided by Instinet for in-house dealing. The Paris Bourse, which was also on the route of the computerisation of trade, was seen as a possible partner in this venture .(Michie, 1999) (p. 505). Yet perhaps more importantly, these fact-finding missions gave the Stock Exchange an opportunity to investigate the National Association of Securities Dealers' Automated Quotations system (NASDAQ) which, as is shown below, became a crucial template for the City of London in the 1980s.

system (Kynaston, 2002). With no access to current prices or to the market-making jobbers of the Stock Exchange, ARIEL lost some of its appeal. And, as Barry Riley, former editor of the *Financial Times* noted, the cynical view had it that 'a computer can't buy you lunch, whereas a broker can, and would' (Riley interview).

ARIEL was too much, too soon, an example of the contingent character of technological success in the marketplace. For a technology to have effect on social structures, observes the economic sociologist Niel Fligstein, there needs to exist a form of social organisation that makes technologies relevant in the first place (Fligstein, 2001). The face-to-face environment of the floor and its associated institutional arrangements were still central to the securities industry. Screens and automated bloc trading did not suit the historically rooted practices of the makers of the equities market in London, configuring ARIEL as an unsuccessful venture. This episode, nevertheless, left one thing clear: the days of the Stock Exchange's monopoly were counted. Great competition lay ahead, and in the brave new world, computers were an increasingly prominent part of the game.

Table 1. Chronology of market information systems at the London Stock Exchange, 1968 – 1992



4 An EPIC Marketplace: the (Re)Materialisation of the London Stock Exchange, 1975-1995

During the three decades following the Second World War, the London Stock Exchange experienced numerous transformations. The old House built in the nineteenth-century was a memory from a seemingly distant past, replaced by a Tower with a trading floor populated by electronic hexagonal pitches. The coaxial network of MPDS extended throughout the City of London and its vicinities, disseminating mid-prices to thousands of users. The digital signals of Country MPDS reached the most prominent financial centres of the United Kingdom, guaranteeing access to the same images observed by the Londoners. Moreover, the machinery of CHARM was becoming a run-of-the-mill element of the overall operation of the British securities industry, bringing settlement a step closer to a paperless (what some would later call dematerialised) state. Yet despite these transformations, the market retained a strong connection to the past. Single capacity was now more than ever the norm. Fixed-commissions persisted for all trades. And the London Stock Exchange continued to be a veritable club-like organisation.

ARIEL, the electronic block trading system developed by merchant banks in the early 1970s, presented the Stock Exchange with an important lesson. However strong the ties between its members may be, however much it continued to present itself as a national institution built upon reinvented historical grandness, the position of the Stock Exchange was not set in stone. The decreasing cost and increasing flexibility of computing and telecommunication technologies mounted a challenge to the Stock Exchange by materialising the possibility of alternative dealing systems that circumvented the trading floor. Indeed, the presence of a thriving market in Eurobonds was proof that face-to-face dealing was but one in a number of possible sociotechnical market configurations. The Stock Exchange was well aware of this. Their missions to the United States and their closeness with the exchanges of

Continental Europe showed them just how diverse the architectures of the market could be. And in learning this diversity, the Stock Exchange deliberated on the future shape of the securities market in Britain.

Of all the possible routes to follow, there was an increased recognition that computer and communication technologies were bedrock to the markets of the future. As early as 1973, the Council had concluded that the 'world-wide provision and reception of market information through visual display screens will in future become a vital aspect of the business of the Stock Exchange and its member firms' (Council of the Stock Exchange, quoted in Michie, 1999). In particular, the data streaming through the cables and computers that were commonplace in international finance had suffered a notable transformation. It was no longer a mere appendix to the market, a by-product of jobbers and their interactions with brokers. It was no longer ten lines of edited company announcements published on a television screen or printed on a sheet of paper. Information mutated into an asset, and within the realm of information, 'fresh' and 'fair' prices were the most coveted resource of all.

The learning curve towards this realisation was steep, nevertheless. Notwithstanding the recognition of information as central to its operations, the attitudes of the Stock Exchange towards information systems fluctuated considerably over time. In 1974, for example, the Stock Exchange toyed with the idea of selling MPDS to Reuters, a growing influence in international markets, who then possessed an infrastructure capable of delivering London prices to Tokyo within four seconds. It took the intervention of Dundas Hamilton, a broker who served as Deputy Chairman of the Exchange, to remind the Council that by doing so they would renounce to the control over their own price information, opening the possibility for Reuters to develop a competing screen-based trading service (Michie, 1999, p. 508). The Stock Exchange hence withdrew from Reuters, zealously safeguarding its prices. Even the relationship with Extel, a longstanding partner, changed due to of the peril of uncontrolled information. From 1975 onwards, Exchange Telegraph, Extel, would no longer be able to collect prices off the trading floor, becoming instead a paying subscriber to the information services provided by the Exchange. With the

consolidation of information services as a central activity of the finance, the Stock Exchange set the stage for a transformation of MPDS.

The initial change took the form of an update. While the members of the Stock Exchange considered MPDS a valuable service, there was room for improvement in terms of the accuracy and quality of the mid-prices it reported. In particular, prior to 1975, the prices displayed by MPDS coexisted with those provided by at least two other services, Extel and the Financial Times. Three different teams of price collectors ran between pitches, acquiring quotes from different jobbers, at different times, and submitting them to different systems with different standards. The prices presented on MPDS were thus not unique representations of the market: there were 'three different teams and what you could easily get at the end of the day were three different versions of the price of a stock like Shell or ICI' (Newman interview). When Extel was denied direct access to the floor, their price collectors were absorbed by the Stock Exchange (Newman interview).

The amalgamation of price collection implied that there was now only one official price for each share. It was thus imperative to assure quality of the prices by introducing faster and more reliable methods of collection and dissemination. The processing capacity of the Argus 400 computer was, nevertheless, a bottleneck for further increases in the rate at which prices could be fed into MPDS. The proposed solution derived from the technical experience gained in the development of CHARM. As occurred with CHARM, a PDP 11/70 from Digital Equipment Corporation was added to the system to serve as an input/output processor. This minicomputer received its price input from a set of upgraded Westinghouse dumb terminals located on the floor of the Exchange, which replaced the original Ferranti terminals installed in 1970 and fed data into the Argus 400 through a digital link. By supplying preformatted messages, the PDP 11/70 reduced the 'number crunching requirement' of the Argus, hence increasing the rate at which prices could be changed (Carey, personal communication).

A reconfigured MPDS allowed the Stock Exchange to enter an altogether different club. In some ways, this slight modification of the price dissemination service was a foray into the markets for data provision. Due to its monopolistic position and tightened regulation on the information it produced, the Stock Exchange arrived at a position where it was able to capture, format and sell prices to specialised data vendors, even individual users. Reuters and Extel were two examples, distributing the prices of the Stock Exchange through their networks across Britain and the world. The new version of MPDS, however, made space increasingly compressible, allowing for the identification of new interlocutors in business. In particular, it showed that space was no impediment for data transmission, and that wherever there was a customer there could be a market for information. The concrete manifestation of this new vision came in the form of a link with Telekurs, a financial information provider founded in Zurich in 1930 as Ticker AG. 'We had the first ever computer link to display data. As far as I know, it was the first ever in Europe. It was [certainly] the first in Britain', recalled Michael Newman, responsible for managing the project. Space was showing its technologically mediated flexibility and, in the eyes of the engineers of the Stock Exchange, the globe was mutating into an electronically interconnected marketplace.

4.1 The (cybernetic) road to EPIC

The attitudes towards the expanded role of technology in the operation of the Stock Exchange and its concomitant relation to information were never entirely homogeneous across the membership. In the early 1970s, brokers and jobbers remained quite wary of the possible demise of the floor due to the emergence of an alternative computer-based dealing system. Yet, as mentioned above, towards the mid 1970s a certain degree of consensus emerged on the role of technology in the future of the Stock Exchange. Just as New York managed to keep its specialist system by giving the floor access to faster means of communication and novel mechanisms of visualisation (see Keith, and Grody, 1988), London could keep its longstanding practices and institutional structures. The apparent contradiction between face-to-face dealing and the computer became a fallacy, domesticating information technologies as a routine element of the culture of finance in Britain. If

anything, new technologies – in particular, those of the type represented by MPDS – transformed the floor into more than a marketplace. The floor, usually described to the public in terms of a wholesale produce market, moved into the light of a different metaphor. The Stock Exchange was also a factory, a place where prices were forged by jobbers out of the specialist knowledge of brokers, to then be digitally shipped through telephone and coaxial cables across the world.

This specific attitude towards information technologies was partly the result of a consolidated 'informatic' culture within the engineering and computing community of the Stock Exchange. This was visible in Peter Bennett's group, which by the mid 1970s had carved a space of its own within the organisation. The milestone that marked this new culture was set in 1976 when the Stock Exchange hired George Hayter to direct its technical services. The decision to hire Hayter, recommended by consultants, derived from the realisation that 'this technology thing was something that was eventually going to take over in a big way' (Scannell interview).

The convergence between Hayter and Bennett was a fertile ground for the expansion of information systems within the Stock Exchange. To some extent, this convergence derived from Hayter's multifaceted background. Originally trained in natural sciences at Queen's College, Cambridge, George Hayter (b. 1938) read numerous subjects – including empirical psychology, philosophy and logic – before becoming an electronics engineer designing military aircraft control systems. It was 'a lot of fun' recalls Hayter, 'sort of grown-up Meccano, really, and actually making things that work […] was great'. Hayter's association with computers resulted from working with Elliot Automation, a British computing company taken over by International Computers and Tabulators, ICT, in 1968. There, Hayter was involved in a project validating analog computing results through digital calculations. It was 'very slow and cumbersome, but thought to be very reliable and more sort of kosher, in some way or other'. While the experience with Elliot Automation got Hayter 'interested in what computers could do', it was during his subsequent time at LEO Computers where he uncovered 'all sorts of new interesting applications' in

commerce. This realisation led Hayter to join the British Overseas Airways Corporation, a predecessor of British Airways, where he was put in charge of managing the development of a computerised reservation system. Named BOADICEA, the system was the first such development outside of the United States, where IBM had launched SABRE in 1964[1]. Altogether, BOADICEA was a feat for BOAC, both in a technical and an organisational sense. The system, in particular, exemplified the adoption of advanced control techniques (e.g. operations research) and computing systems within British industry (see Littlewood, 2005). For Hayter, participating of the development of BOADICEA resulted in a specific – and, as time would prove, quite critical – set of organisational skills. The development of the reservations system required managing with a complex bureaucracy and coordinating tasks across several technically distinct groups.

> There was passenger checking, passenger ticketing, passenger fare construction, weight and balance calculations, route optimisation, all this sort of stuff was being done online. And that was thrilling because it was really leading edge, real-time computing, you know, for the first time for me. That was in 1968, and I was there until 1976. I was in charge of real time system development. A team of about 120 system designers and programmers, documenters, testers and so forth. And we also sold that package of software, which amounted to about 500 man years of work, to other airlines around the world. So I had little teams of people dotted about the place. I got to work on a sort of global canvas which turned out to be important later on (Hayter interview).

The confluence between Hayter with Bennett came in the form of a shared metaphor of the market that resounded with the technological direction taken by the Stock Exchange. For Hayter, in particular, it was clear that digital technology 'needed to be introduced in order to broaden the scope of the information systems'

> Because I could see that trading securities, is pretty much a hundred per cent information flow. There isn't much else, really. I mean, there's paper, but the paper represents information and there were ways in which I could see that the paper could be immobilised so that the whole process could be represented as information flow. Starting with market information to the broker and his client, generating an order. It doesn't have to be written on a

[1] SABRE originated as a civilian spin-off of SAGE (Semi-Automatic Ground Environment), a large-scale computerised command, control and communications system built in the United States in the 1950s for providing continental air defense against the possibility of a nuclear strike. For a history of the development of SAGE see Campbell-Kelly & Aspray (1996) and Edwards (1996).

> piece of paper as it was then. It can flow straight into the market, it can be executed against a jobber or market-maker's quotation, the resulting trade can then be generated and recorded and then passed on to settlement and generate the necessary trade contractual exchange of ownership, and exchange for money. And money is information as well, with the depositary which [electronically] keeps track of the ownership of shares in the United Kingdom and the banking system for transferring money. The whole blazing thing is actually information flow, from start to finish (Hayter interview).

Permeating the design of systems, an informatic metaphor was adopted by the technological communities of the Stock Exchange, presenting the market as a series of information flows, feedback loops and technologically mediated reflexes. For both Hayter and Bennett, the market could not be reduced to either an inherent equilibrium derived from individual rationality or to the whims and worries of speculators and informed investors. For them, the complexity of the market necessitated an informatic interpretation, modelled on the quasi-cybernetic systems underlying computers and automated avionic control mechanisms.

Bearing a common metaphorical heritage and similar experiences in college and industry, Hayter and Bennett cultivated a unique engineering culture within the Stock Exchange. For George Hayter, the successful development of BOADICEA proved the commercial feasibility of large-scale real-time computer systems in an essentially international business. Indeed, the growing scope of real-time computing applications in business confirmed its technological and organisational viability. For those building the information systems of the London Stock Exchange, real-time computing became the primary path to follow when designing technologies for the marketplace. After all, information cannot flow in a world of mainframe-based batch-processing. The rift that originally distanced Bennett from the technical activities of settlement was now the source of an alliance with Hayter. Although Bennett ended up reporting to Hayter, 'the pair of them made a good combination' (Scannell interview): while Hayter 'had kind of a political mind, [knowing] the right way to go about things', Bennett was the technological entrepreneur guiding 'a sort of forward-looking outfit, crazy techies, who were fantastic, some of them were real cutting edge' (Cox interview).

The systems of the Stock Exchange, however, were a long way from the real-time computing and communication networks that existed elsewhere. Between the flow of information and the transformation of the trading floor into a factory of actionable prices, there was a fundamental architectural roadblock. In a sense, the prices displayed on MPDS were not the type of signs that moved the market, they were not triggers of action. The system was 'extremely crude', recalled Scott Dobbie, formerly a broker with Phillips & Drew (Dobbie interview). The real price 'was always on the floor', the place one had to access to execute an order or discover the best bids and offers for particular shares[2]. To an extent, the temporalities created through MPDS, within finance on the floor, and the practices in the offices of brokers and jobbers had yet to converge (Miyazaki, 2003). To be used and interpreted as actionable signs by the community of brokers and jobbers in London, the prices on MPDS required a series of mutations. Above all, it was necessary to impose upon them a certain standard, a form of authority and centralisation that gives digital bits their apparent universality. Such standard came in the form of a unique price collection mechanism within the Stock Exchange. Restricting access to trading floor of the Tower made the Stock Exchange's information systems a point of obligatory passage (Callon, 1986) for those wishing to observe and interact with London's market. This primacy in finance was guaranteed not only by controlling the dissemination of prices and their consequent transformation into scarce commodities, but also through the standardisation of their production.

Electronic mid-prices were therefore made valuable things; they became commodities. But for these valuables to flow, for them to be utilised across time and space, two further changes were required. The first, guaranteeing real-time access to all the quotes in the market and aligning the temporalities of floor and screen, was for now too large a shift in the practices of the Stock Exchange. The second, however, was more socially permissible. Prices had to be malleable; they had to be flexible and usable. Owing to their analog nature, the signals and screens of MPDS

[2] This was, in fact, a sociologically relevant difference between the stock exchanges of London and New York. Unlike New York, where the stock ticker became the dominant mode of visualising and interacting with the market (Preda, 2008), MPDS and the systems that followed in London did not lead to an erosion of face-to-face dealings. Conversational turns predominated in London until the end of 1986 as the only legitimate means of accessing the market of the Stock Exchange.

allowed no modification to or further electronic processing of their contents. The prices fed into the Ferranti Argus 'were only used on that system. They could not be put to any other use' (McLelland interview).

4.2 A digital heart for the EPIC marketplace

The need to create flexible and malleable data-feeds provided an incentive for the Stock Exchange to replace the computational core of MPDS. In practical terms, the architecture of the Argus 400 was an obstacle to the expansion of digital services for the market. However relevant, the link with Telekurs could not be taken to more users, and MPDS itself could not be reconfigured to handle more shares without affecting the quality of the output.

The solution conceived was to replace the Argus 400 with a PDP 11/70, allowing for a critical innovation, namely, the construction of an electronic database for market prices. The project, initially labelled Exchange Price Input Computer, EPIC, was a joint financial venture between the Stock Exchange and Exchange Telegraph. As Michael Newman recalls, the use of the word 'exchange' 'was deliberate, because [Extel was] Exchange Telegraph and we were the Stock Exchange, so the common word was 'Exchange', so that [EPIC] could mean [both] Exchange Telegraph Price [Input Computer] and the Stock Exchange [Price Input Computer]' (Newman interview). The financial backing of Extel was based on a clear rationale, as it had a vested interest in the development of reliable data dissemination systems. Facing increased competition from vendors such as Reuters and Datastream, Extel considered the development of a system for distributing prices 'as a digital feed to everyone' (Scannell interview) a profitable and necessary venture. In any case, the digital distribution mechanisms of EPIC could facilitate Extel's main business of providing financial information to British newspapers (Buck interview). The ultimate design of EPIC, however, remained in the hands of Bennett's team. Hence, the organisational template for the system came from the tried and tested collection protocol of MPDS: the current prices of shares were entered from the market via price input terminals located on the edge of the floor. The difference was that these prices were sent to a database 'which held information

about every stock traded on the floor (identified by its 4 character EPIC code) such as yesterday's closing price, today's opening price, the last few prices etc' (Buck, 2008).

Figure 4.1 Engineer testing EPIC, c. 1977. Courtesy of John Scannell

As the project evolved, other types of information were added to the service, leading to is renaming as Exchange Price Information Computer. EPIC incorporated such elements as market-related news items and headlines, and specialised programs that managed official publications requiring accurate and up-to-date data. Particularly important was the *Stock Exchange Daily Official List* (SEDOL), produced every night by the Stock Exchange, containing the official prices of all the securities listed in the market. SEDOL was not merely an element of routine documentation. All tax, probate and portfolio valuations carried out in the United Kingdom referred to the prices in the *Official List*. Maintaining the list was a laborious task. While there were only about 2,500 regularly traded stocks that needed an EPIC code there were about 10,000 listed stocks that each had a SEDOL code (Buck, 2008). Along with a program that facilitated the production of SEDOL, EPIC also dealt with the creation of the *Weekly Official Intelligence*, WOI, a collection of company announcements and relevant market news.

EPIC went online in 1977 amid little pomp. For the users of the Stock Exchange, the introduction of the system was surreptitious: EPIC did not transform the screens of MPDS nor the quality of the documents published on a daily and weekly basis by the Stock Exchange. Everything seemed to be the same. At the level of infrastructure, however, EPIC embodied a change in the role of information technologies in the organisation of finance. In particular, EPIC demonstrated that a computational system – none other than a database – could become the core of the financial marketplace. EPIC was able to gather within a single unit the different inputs from the floor, moulding them into data-feeds that challenged geography by reaching distant corners of the British Isles through cMPDS and overseas countries through the distribution networks of Extel.

These feeds, furthermore, were malleable. Unlike the information produced with the previous incarnation of MPDS, EPIC allowed Extel to gather the information from the market and tailor its presentation according to the specifications of the numerous newspapers it serviced.

> The Glasgow Herald, for example, would have its list of stocks and its defined output. [They] might, for example, cover 900 stocks in its paper and it might [have] wanted a 12 character name or something and the price [immediately after] that. So the extraction [program] worked out who the customer was and what he wanted his layout to look like. Because each newspaper has a different layout, [length] in characters as well, so that the new computer system would [extract it] and then send it electronically to the newspapers (Newman interview).

The social appropriation of information feeds – that is, their incorporation to the practices of particular groups – was not instantaneous. Some, in fact, considered the automation brought by data-feeds as a threat to established relations. Newspapers illustrated the defiant reception given by some to the digital flows of EPIC. Michael Newman recalls with bewilderment how some of the newspapers that bought data-feeds from Extel 'still printed out [the formatted layout] and typed it back in again because the union operators had jobs for life as the typists. So amazingly this thing was still getting the computer printing it out exactly as they wanted it and they would type it in, oh what a job' (Newman interview).

Initial opposition notwithstanding, the community of brokers and jobbers in London as well as some non-member users embraced the malleability of the feeds from EPIC; 'it was clear that people started to want real time feeds' (Buck interview). With the expansion of computing within the financial community of the City of London, it was now possible for individual users to connect directly to EPIC in order to receive the most up-to-date information possible without accessing the floor. This resulted in the creation of a separate service, the Computer Readable Services, which offered a portfolio of data feeds for various subscribers and replaced the earlier custom feeds such as the news agencies and tapes (Buck, 2008). A new materially mediated modality of finance was emerging within the City of London.

At the level of metaphor, EPIC was a departure from previous conceptualisations of the market. Specifically, EPIC was an expression of the feasibility of 'dematerialising' finance through a cybernetic transformation. The routines once performed by individuals working in concert towards a single calculative end translated into self-contained processes running on a PDP 11/70. The organisation of the market, in a sense, was reduced to one of its computational representations, with humans becoming sources of input for the system. The DataBase Handler (DBH), which ran as a process called DBHD80, mimicked the clerks that once stood on the pitches of jobbers updating Perspex whiteboards in the House. Both the price input program and the company announcement program signalled DBH when data was entered into the terminals, validating the contents and assuring the integrity of the digital repository. A display program formatted the data for its transmission to the screens of MPDS, updating the contents upon receiving an instruction from DBH. An output process created a log for every transaction, recording it on a magnetic tape. And a response program, coupled to a watchdog timer, served as an indicator of the failure of the system by regularly polling EPIC and sounding an alarm if a response was not received. Although it did not bear a one-to-one correspondence with the organisational arrangement of the market, the division of labour between the processes running on EPIC emulated the operation of a bygone Stock Exchange.

The successful operation of EPIC hinged on a series of transformations of its social surroundings. In particular, the market, understood as a collection of brokers, jobbers, clerks, prices, securities, devices and practices, was cast in a language amenable to EPIC and its organisational appendages. People and things, in particular, were parameterised. Just as EPIC led to the characterisation of the clients of Extel in terms of a number of pre-set instructions, it also introduced a new conventionality for the shares in the market. On the one hand, the EPIC codes introduced by the Exchange set a unique standard for the identification of companies and shares. On the other hand, shares were differentiated through their location within categories built upon perceived price behaviours.

> We expanded the database to about two and a half thousand [shares] on it, and we basically put them in three tiers. The active stocks, which sort of then became the FTSE 100. [These were the] top 100 or so stocks. The price reporters were told they must keep them up to date at all times. [T]hey were 70 per cent of the trading going into those stocks. Then there was the next [band?] somewhere in the middle […] and then the last stocks were [those] we only needed to make sure [were] updated once a day. So the middle band would be a few hundred, and the rest were in the 'make sure you've got once a day' (Newman interview).

This, in a sense, entailed a double modification. While the world was fixed to the demands of EPIC, the parameters of the system were made significant only through the carrying out of particular practices. Price collectors had to adapt their behaviours to the new categorisation of the market in order to guarantee the stability of the three tiers of shares. Failing to adopt particular behaviours (e.g. failing to update the prices of the most active shares) led to a breakdown of the system. The (incidentally long) survival of the EPIC codes, as well as of the three levels of prices, hence depended on a co-modification of social and technological arrangements, on the development of new conventionalities that allowed the EPIC marketplace to function, in short, on new set of organisational routines centred around the market/machine.

The centrality acquired by EPIC should not lead us to put too much weight on either the dematerialisation of the market or the mechanisation of economic relations in the Stock Exchange. On the latter, the parameterisation of shares still relied on a highly interpersonal, almost tacit, form of knowledge. The tiers, for instance, were not 'fully defined […] People knew what the stocks [were]' (Newman interview).

Indeed, EPIC formed part of the broader social mesh of the market, where face-to-face interactions, conversational exchanges, and interpersonal forms of knowledge continued to base economic relations and the calculative efforts of agents in the marketplace. On the former, EPIC was quite a material enterprise. Although elements of the market were represented by processes running on the PDP 11/70, a large infrastructure remained. As the Argus 400 that preceded it, the PDP 11/70 was a tangible entity associated to tangible organisational routines. The most visible material consequence of EPIC, however, was not to be found in the copper wires sending signals from London across the world or in the circuits that comprised the PDP 11/70, but rather in the rapid expansion of the size and remit of the technical services team of the Stock Exchange. What started as a handful people grew by orders of magnitude in the following years. The 'dematerialisation' of the market was proving to be a tricky endeavour requiring an army of experts responsible for building and managing the (materially present, though increasingly invisible) *agencements* of the marketplace.

4.3 The birth of SSG

The organisational correlate of EPIC was the creation of a specialised section within the Stock Exchange charged with developing information and communication technologies for the market. The group, which bore the title of Special Systems Group (SSG), centralised the projects on market technologies, most of which were then headed by Peter Bennett, within a single unit (McLelland interview). Under the supervision of George Hayter, the SSG was responsible for guiding the technological trajectory followed by the Stock Exchange in the years leading up to Big Bang in 1986. Special Systems 'was sort of like being in a research department in a university. Everyone was a graduate [,] smart people' recalled Peter Buck, who joined SSG in 1979. It was, nevertheless, a research department in the City of London, embedded in an organisation that sustained a 'yes sir, no sir' attitude towards superiors (Sheridan interview), and surrounded by a financial culture that mixed gentlemanly ideals with masculine bravado (themes dissected in closer detail in the following chapter).

> It sounds cliché now, but [..] the culture was very much work hard play hard. So it would not be unusual to see people still there at eight or nine o'clock at night, because they were working on a project. And, you know, we needed to get it done and projects tended to be very short term, three month[s] or whatever. So people would work very hard to get things done. And then, you know, Friday night or whatever, you'd go out and get absolutely plastered because, again, it was the City and that was the culture in the City (Buck interview).

The work hard/play hard culture of the technical team combined with the pre-existing attitudes towards the design of information systems (e.g. systems programming and a bias towards real-time computing and communication). In effect, the SSG was the locale of technological innovation within the Stock Exchange. Their approach towards the development of systems was part of their strength: 'I learnt some powerful skills from Bennett and Newman', recalled Ian McLelland.

> Keep development teams small and effective – more than six people? – rethink the structure […] Prototyping – better to show the product than produce mountains of documentation (the Achilles heel of settlement development). This was against the traditional development cycle at the time, but was hugely successful in getting the requirements right up front and proof of concept […] Work Breakdown Structure – Similar to small teams, keep the work packages small and deliver often. Can't develop weekly? – break it down further. (McLelland, personal communication).

Much like the popular image of the dot-com firms of the 1990s, the SSG was initially small (in the recollections of Buck, around 23 out of 800 employees of the Stock Exchange) and composed of relatively young engineers and programmers. The head of the SSG was a by then experienced Bennett. In his words, the success of previous endeavours (not so incidentally coupled to his political abilities) implied that, in the eyes of the Council and the membership, he could 'do no wrong. I mean, they gave me more or less a carte blanche to automate everything inside' (Bennett interview).

Bennett's technical achievements contributed to the wide support given to the projects and continuity of the SSG, not to mention its ever-expanding budgets. Even so, a critical form of endorsement to technology and the work of the SSG came from the close collaboration between George Hayter and Patrick Mitford-Slade. Mitford-Slade was the direct liaison between the Council and the technologists working for the Stock Exchange. A partner of the highly reputed stockbroker Cazenove since

1972, Mitford-Slade had first-hand knowledge of the various activities involved in the operation of the Stock Exchange. After twelve years in the army where he served as signals officer and achieved the rank of captain, Mitford-Slade joined Cazenove in 1968. His first six months at Cazenove were spent as a clerk in the contract and settlement departments, which constituted a sort of 'basic training' on stockbroking. The partners then realised 'that they were wasting my time and theirs, and they put me into the New Issue department for the next 18 months', completing his two years of basic training. At New Issues, Mitford-Slade and his three colleagues did 'everything in dealing with the Stock Exchange for listings of securities and that sort of things' (Mitford-Slade interview) giving him a particularly close understanding of organisational procedures. He was then seconded to the board of the Takeover Panel, created in 1968, and after two years, returned to Cazenove to head the money broking side of the business. During this time, Mitford-Slade accompanied the visit of then Deputy Chairman David Roy-Lewis to Washington and New York, which, as mentioned in the previous chapter, was a response to the threat of the automated trading system ARIEL. The visit to America gave Mitford-Slade a closer look of the state 'of international regulation at this stage'. Equally importantly, it got him interested in electronic technologies. As he mentioned,

> When I was out in New York and Washington on this expedition we saw the first word processors, and we were astounded the secretaries could actually manipulate all this on a screen. And we were thrilled by that. And I got quite interested on that side of things (Mitford-Slade interview).

In 1976, Mitford-Slade was elected to the Council of the Stock Exchange, where he became 'quite a valued member'. Particularly relevant, however, was his appointment as the Chairman of the Information and Communications Committee, the organ that had overseen the development market systems since the initial days of MPDS. Reflecting its wider remit, the Information and Communications Committee changed its name in 1979 to Technical Services Committee. 'People got a bit confused with the name "information and communications"', said Mitford-Slade. 'They thought we were PR or something. But we weren't PR. We were definitely technology'.

4.4 The limits of analog

With the introduction of EPIC in 1977, the Stock Exchange was preparing to enter the technological playing field of an increasingly global and electronic financial system. Changes in the structure of the domestic and international securities industry – such as the liberalisation of exchange rates in 1972, the development of electronic dealing systems in North America, the growth of institutional investors and the consolidation of foreign investment firms in London – led the Information and Communications Committee of the Stock Exchange to pursue a next step in data provision. For Mitford-Slade, Chairman of the Committee, 'MPDS was marvellous, as far as it went. It only had 22 pages of information, and it was really just listing the shares on those 22 pages with an up-to-date market price on it' (Mitford-Slade interview). Whatever the solution implemented, the system replacing MPDS needed to be both commercially viable and able to handle 'an unlimited amount of information' (Mitford-Slade interview).

The Special Systems Group was particularly aware of the technical limitations of MPDS and had considered, as early as 1975, 'moving the system forward' (Scannell interview). The roadblocks for scaling up MPDS were clear to them: to increase the number of channels was simply prohibitive due to the required bandwidth. The expansion of MPDS had reached a point where the 22 channels 'squeezed every available bandwidth […], so much so that the gap between [them] started to get almost blurred' (Newman interview). The system was 'absolutely at its limits', as Michael Newman recalled. The pressure to expand, furthermore, only increased with time: as new instruments entered the market, users demanded additions to the service, such as when traded options were re-introduced to the floor, forcing the SSG to implement a time-sharing system on the channels in MPDS. The data displayed on the screens would switch every ten seconds between market sectors, allowing for the visualisation of the prices of traded options while keeping the system at 22 channels. However, 'people really didn't like it, because if you were trading you didn't want the bloody thing to switch on to the other page when you were looking at the stock prices' (Newman interview).

The issue was not merely one of the quality of visualisation. Problems in maintenance and the general reliability of MPDS also suggested that a different approach was necessary. The modified television screens MPDS required considerable work. The engineering teams of the Stock Exchange would 'go round and service these damn things. And sometimes, after sort of five years, the screen would be very fuzzy and you could barely make out the […] characters' (Scannell interview). The core hardware on which MPDS ran also had its peculiarities. For example, the digital-to-analog video converter that allowed sending images via coaxial cables relied on a crystal that operated at a set frequency. The efficiency of the crystal varied greatly according to the environmental temperature.

> [If] it was a warm day and it was a bit warm in the computer room, [the crystal] would [lose its original resonance frequency], which would make the characters on the screen to start to tear, because it wasn't in synch. [What] we had to do [was] to open the door of the Ferranti Argus about 2 inches to cool it down and that would allow the frequency of the crystal to go back to where it was originally set (Scannell interview).

The technological mashup of digital computers, video converters, signal amplifiers, television emulators, and miles of coaxial and telephone cables rendered the materialities of MPDS an awkward solution for future expansion.

4.5 TOPIC for the market

The replacement of MPDS came through a serendipitous confluence of technological innovations. In the late 1970s, real-time computing was an established technological design/practice, both within computer engineering and in broader commercial applications. Financiers in Britain had a decade of experience as 'push-button devotees', making electronic information systems socially acceptable. And a new communication system had been developed which could potentially solve the bandwidth and modularity issues of MPDS.

The system in question was known commercially as Prestel and belonged to a broader set of data-dissemination technologies called Viewdata. Developed by the British Post Office, Prestel was a 'marriage of industries, technologies, processes and skills' in 'telecommunications, the telephone, the computer, and publishing' (Fedida & Malik, 1979, p. 2). Prestel was an information publishing service whereby a

computer sent data to modified colour televisions sets using conventional telephone lines. Users of Prestel were provided with either a dial-up modem or an acoustic coupler and a keypad with which they could connect their television sets to navigate through the numerous indexed pages of the service. Each page consisted of 80 columns by 40 lines of characters. By pressing specific buttons on the keypad, the user could request to download a particular page. Unlike its predecessors, such as Ceefax (offered by the BBC to send information as Teletext), Prestel was an interactive videotex system as opposed to a unidirectional broadcast. In other words, Prestel allowed for communication between the user and the computer. Prestel made use of a technology that is widely known today, namely, an asymmetric communication channel: users only had to send short requests to the computer in order to receive the selected page (the initial upload/download speeds were in the order of 75/1200 bytes per second). Indeed, many hailed Viewdata technologies as a basis for the interactive data communication systems of the future, 'if some method of breaking into the mass market could be found' (Fedida et al., 1979, p. 7). Electronic diaries, electronic mail, on-line video games and even a home movie-by-wire delivery service were the potential applications envisioned for Viewdata, most of which are captured by a currently pervasive asymmetric communication technology, the internet.

For techies like Bennett and Scannell, Prestel 'looked quite good' as a replacement for MPDS (Scannell interview). Not only did it preserve the established economies of conventional television sets ('people had got very used to TVs and the cheapness of them blended in well with the concept of having a TV terminal', said Bennett), but it also relied on the existing network of telephone lines and re-introduced colour into the visualisation of the market. The system thus devised by Bennett, named TOPIC for Teletext Output of Price Information by Computer, used Prestel as a technological blueprint.

The development of TOPIC implied some important technical departures from Prestel. While EPIC was sturdy enough to serve as the repository of the price and company data displayed by TOPIC, the mechanism for updating the pages on Prestel

was an important hurdle. As a price visualisation system, TOPIC could not be slower than MPDS. The users of MPDS were used to the quasi-instantaneous updating of prices: Due of the previous experience of MPDS, 'there was a requirement to have something on [the] screen pretty rapid[ly]' (Scannell interview); to change from one channel to another in MPDS took as much time as it did in a conventional analog television set, roughly the time it took an electron beam to scan the screen. Yet in a standard Prestel system, users had to request the screen to update without knowing if new information had been fed to the computer, therefore exerting a higher load on the communication channel and forcing users to keep the keypad constantly within reach.

To deal with the real-time requirements of the users, Bennett designed a 'super Prestel' (Newman interview) that took the original interactive Viewdata technology and made it 'formal and reliable' (Bennett interview). In TOPIC, the television sets were given 'some extra logic' allowing them to render the teletext signals that came from the terminal. The terminals, developed by BARCO, the Belgian electronics manufacturer, were boxed in a metal casing to endure life on the floor and in the office. Groups of up to twelve terminals were connected to purpose-built multiplexers that linked to a switch, itself linked to a high performance process control machine. In effect, these process control machines gave TOPIC both its modularity and its speed. Built by Modular Computer Systems Inc, these control machines (MODCOMs) were originally designed for uses in aerospace and industrial applications. (Bennett remembers, with some pleasure, that NASA used these computers. Although expensive at £220,000 each, he thought that if TOPIC was going to work 'that's the only way it's going to work'; Scannell interview).

The MODCOMs provided a reliable link to the databases of EPIC, being able to have 'have a thousand test points connected [to] either a rocket engine or an army 211 [Rolls Royce] engine' or, in this case and by proxy, the market floor (Scannell interview). With 128 ports potentially connected to 12 terminals each, one MODCOM could service more than 1500 users. With this arrangement, the number of pages available to the market was only restricted by the storage capacity of EPIC. Soon

enough, the 22 channels on MPDS became several hundred pages on TOPIC. The 16 channels of prices moved to a ‘magazine’ of 100 pages; the 4 channels for company news and announcements also reached a magazine of more than 100 pages; and pages for indices, currencies and traded options proliferated throughout the new system (McLelland interview). TOPIC was ‘ahead of anything that Reuters was running at the time’ (Bennett interview) and provided, in a sense, a completely novel informatic life-form for the market.

Figure 4.2 System-testing TOPIC, c. 1980. Courtesy of John Scannell

The driving force behind the development and subsequent introduction of TOPIC resided in the expanding armies of technicians working around the market floor. For Patrick Mitford-Slade the process was ‘definitely bottom up’, with ideas coming from people who ‘knew what technology was available’, particularly, the Peter Bennett’s and George Hayter’s of the world. The ‘technocrats’ ‘had to sell [their ideas] to me and I had to sell them to a lot of people who didn’t understand technology whatsoever’ (Mitford-Slade interview). TOPIC was particularly illustrative of the organisational dynamics supporting the development of market information

systems at the Stock Exchange. Although some were aware that MPDS needed a replacement (particularly, the SSG and the Information and Communications Committee), for many members and users of the market the system was a solution in search for a problem. The initial reaction of the Stock Exchange to TOPIC largely reflected both this perception as well as the system's technical origin. 'Many members of the Committees didn't believe TOPIC would be a success', recalled Newman. 'They thought people liked MPDS and had learned to live with it'.

> I remember going to one brokerage house […] when I went around to find out what people wanted. [And a broker there told me] 'colour will come into this trading room over my dead body', he said, 'it's a complete gimmick, we don't want it' (Newman interview).

For the Council, the project 'was quite an investment to launch into [requiring] quite a lot of persuasion', recalled the then Chair of the Information and Communications Committee, Mitford-Slade. To sell the new system to his peers, Mitford-Slade found inspiration paraphrasing a well-known slogan for Heineken by assuring that 'TOPIC reaches parts MPDS cannot reach'. Years of trust backed the concerted negotiations between the technologists, their supporters among the membership and the Council, leading to the ultimate approval, development and introduction of TOPIC in 1979. 'In fairness to them', recalled John Scannell about the Council, 'we'd got the proper documentation. They were quite confident we knew what we were doing. Their own firms were suffering because they'd really needed this equipment for their business, so it was very interesting times' (Scannell interview).

Once online, TOPIC gained credibility rapidly, not least because the new system allowed member firms to visualise data through colour, text, and graphics and share information within closed user groups (Newman interview). (In fact, the number of pages associated to closed user groups quickly surpassed the number of pages for prices). Within two years of its introduction, the number of TOPIC terminals rose from the 400 initially authorised by the Council to several thousand. The purchasing of hardware to extend the system became much easier. As Scannell mentioned, when 'you've got 2000 orders outstanding'

> you could not spend enough money. It was virtually impossible. And you had people screaming at you because the place is absolutely booming, you know?

> There's people ringing up, 'can you install one of these next week, I'll give you, personally, I'll give you X to sort of install it.'

Even those who had once considered colour a gimmick were a few months later 'complaining to the Council that his firm [didn't have the terminals that they wanted]' (Newman interview). Numerous additions followed the expansion of TOPIC. Without much resistance from the authorities of the Exchange, the number of MODCOMs increased; to facilitate access to highly used information, the SSG set up a cache of the most requested pages; and to ensure overall lower response times, the technical teams installed a Winchester disk that provided higher speeds and increased reliability.

4.6 The ripples of ARIEL

According to George Hayter, by the early 1980s the service provided by TOPIC and EPIC had been widely recognised as a 'great success'. TOPIC was the new Aston Martin of the City of London, with a two-year waiting list for delivery and a long queue of firms anxious for their terminals to arrive. It cost about a tenth of similar developments in Reuters, and had 'a superb way of [using] colour [instead of] black and white, a superb performance, very fast response [rates] by some very clever programming, and a proprietary network which was very high performance' (Bennett interview).

The development of TOPIC, however, occurred in an environment of mounting political pressure against the Stock Exchange. Although it seemed that the Exchange was progressing smoothly into the 1980s through the provision of better services and a greater centralisation of the British equities market, this was but a façade. In effect, pressure had built up for almost a decade. The structure and mode of operation of the Stock Exchange was becoming increasingly untenable for the large institutional investors that dominated the post-war market. International competition was afoot, thriving under the shadow of the Stock Exchange. And the meaning of technology for the marketplace was still an issue of debate, negotiation and experimentation.

The almost imperceptible uncertainty surrounding the Stock Exchange in the late 1970s originated, one could say, from the introduction of the electronic dealing system ARIEL. Not only did ARIEL open the possibility of finance conducted through electronic and automated means, but it also led large investors and financial institutions to question the raison d'être of the Stock Exchange within the larger order of the market. However much a national institution it may have once been, the Stock Exchange was anything but a fact of nature, an inherent and immutable feature of the British securities industry. The political efforts associated to this newfound opposition, most of which focused on the fixed-commissions structure that dominated finance in London and that gave ARIEL its original appeal, led the Board of Trade to require the Stock Exchange to register its rules and regulations with the Office of Fair Trading in 1974. For some, the national institution was transmuting into a monopolistic and anticompetitive cartel, and as David Kynaston (2002) wrote, a long slow fuse had been lit.

The referral of the Stock Exchange to the Office of Fair Trading (OFT) was initially a mute issue. The existing Restrictive Practices Act 1973 had been 'drafted by a Conservative administration' and was 'not intended to impinge on the operations of self-regulatory bodies such as The Stock Exchange' (Hamilton, 1986, p. 10). The passing of a revised Act in 1976, however, was less sympathetic to capital markets, making their so-called restrictive practices illegal. Upon registering its Rules and Regulations along with its Code of Dealing, permanent notices, and other Council directives, the Stock Exchange received a letter from the OFT in June 1978 indicating that seventeen restrictions were identified. Of these, the two most pressing concerned fixed commissions (which were deemed as limiting the freedom of brokers in supplying services to their clients) and single capacity (relating to the operation of the market). The notice marked the beginning of a defining legal battle between the Stock Exchange and the OFT, generating disquiet amongst the government and the City that the 'future operation of a national undertaking […] was to be decided in a court of law' (Hamilton, 1986, p. 11).

Planning for the court case continued apace within the Stock Exchange. During the course of legal preparations, the Exchange was successful at stressing the role of single capacity as a means for preventing conflicts of interest within a self-regulated environment. Neither the government nor the financial institutions of the City of London desired an end to the division between brokers and jobbers, considering it a stabilising factor in the market (serving as a crucial element in their policy for improving investor protection; see Michie, 1999; see chapter 6 for a discussion on investor protection). The Stock Exchange reaped the tacit acceptance of single capacity, building a so-called 'link' argument (Mitford-Slade interview), that maintained that fixed commissions and single capacity were co-integral parts of the system: if the court eliminated the former, the reduced profits of competing brokers would lead them to act as principals in order to avoid the costs implied by the jobber's spread; jobbers, on the other hand, would have to act as agents since they would be at a competitive disadvantage vis-à-vis brokers. The OFT was not entertained by the idea. They were only willing to accept a 'total surrender, which was doing away the minimum commissions, and doing away with membership rules, doing away single capacity' (Mitford-Slade interview).

The election of a Conservative government in 1979 seemed to provide an opportunity for getting the case dismissed. Many within the Stock Exchange assumed that a Tory government would be friendly to the activities of a long established (and largely establishment) City. Nevertheless, the incoming government, headed by Margaret Thatcher, was a 'very radical conservative government' that 'didn't like clubs and […] didn't like monopolies' (Riley interview). The case thus persisted, despite the political efforts of the Council of the Stock Exchange and its Chairman, the broker Sir Nicholas Goodison. The impending court case set for October 1983, and the possibility that the Stock Exchange might have lost its legal battle hence paralysing the British securities industry, motivated the identification of alternatives. Following the general election of 1983, which the Conservatives won, Sir Nicholas Goodison met with Cecil Parkinson, Secretary of State for Trade and Industry. By then, the government was sympathetic to the predicament faced by the Stock Exchange. The meeting proved critical. In July 1983, an agreement was

reached with the authorities whereby the OFT dismissed its case if the Stock Exchange

> [dismantled], by stages and with no unreasonable delay, all the rules which at present prescribe minimum scales of Commissions, and to complete this dismantling by 31 December 1986. (Goodison quoted in Michie, 1999)

In the broader history of British finance, this pact between Parkinson and Goodison stands as the narrative climax marking the redefinition of the Stock Exchange. However, the court case was but one (undoubtedly prominent) among a great number of factors leading to the transformation of finance in the United Kingdom in the 1980s. Technology, regulation, changing patterns within the industry, and broader transformations of financial and social life contributed to re-configuring the market. Change had been deemed necessary as early as the days of the fact-finding missions to North America in the years surrounding ARIEL's introduction. From there on, a sense emerged that

> London had rather had the blinkers on for a number of years. [The membership] sort of regarded the London Stock Exchange as the premier one of the world, and that there is only one way of doing things and that is London's way (Hayter interview).

The Parkinson/Goodison agreement merely catalysed institutional transformation, freeing the Stock Exchange from the constraints of the court case, forcing its membership to re-evaluate their remit. In effect, the case had 'made us look at our rules and principles', as Peter Wills remarked (Wills quoted in Michie, 1999, p. 552). Soon after Sir Nicholas Goodison announced the deal to the membership, it became clear to most that, as the 'link' argument suggested, dismantling fixed commissions entailed the de facto end of single capacity. A bicentenary tradition, a longstanding market structure, was coming to an end.

4.7 (Re)creating the market

The Parkinson/Goodison agreement, however, did not specify the mechanics of change. Aside from the deadline, the Stock Exchange was left free to decide how it would proceed with reform. The future of the Stock Exchange, 'the way we changed', noted Mitford-Slade in interview, 'was entirely our own decision'.

From the outset, it was clear that the market in overseas securities was a prudent area for the introduction of negotiated commissions – as explored below, this area was arguably feeling the most pressure for change and, in the view of the Council and market participants, was easier to isolate from the UK securities market. The market in domestic securities, nonetheless, presented thornier issues. The membership considered three possibilities for implementing changes. The first, 'class-by-class', entailed removing the minimum scale of commissions successively across different sectors of the market. The second, 'top-slicing', approach implied a progressive reduction in rates, culminating in the complete elimination of fixed-commissions. The third involved the introduction of negotiated commissions in a single step, an approach that was consequently termed 'Big Bang'. According to Michie (1999), it was clear by February 1984 that both the 'class-by-class' and 'top-slicing' approaches were impractical for they presented scenarios in which the rate of change became uncontrollable due to the competitive pressures from institutional investors. Above all, the Council wished to monitor and control change. The idea of a single moment of market restructuring, a single Big Bang, was thus chosen.

Recognising the inevitable end of single capacity and having embraced Big Bang as their approach to reform, the Stock Exchange still faced the issue of choosing the market structure for the future. It was clear that Big Bang implied much more than the elimination of fixed commissions, as explored in an April 1984 discussion paper issued by the Council. There, it was recognised that

> [the] dealing system must change and that any new system must be available by the time minimum commissions are dismantled. In consequence, the present membership and entry rules will also need to change […] and the structure and constitution of The Stock Exchange must be adapted as far as is necessary to accommodate these changes. [Outside] houses will in due course be admitted to Stock Exchange membership in some form, in order to prevent fragmentation of the market [as endorsed by the Bank of England] (Council of the Stock Exchange, 1984).

Whichever market structure was eventually adopted, the Exchange deemed three objectives as guiding its final choice. First, the new market should provide an optimum degree of liquidity given by continuous dealings that encourage the highest possible exposure of orders to each other. Second, the new system must preserve, in some form, adequate investor protection by minimising conflicts of interest and

ensuring that bargains are made at fair market prices. Third, the post-Big Bang market should reflect the 'natural evolution' of the global securities industry yet be flexible enough to allow for local contingencies. As the Council noted, the transition had to reflect the particular circumstances of British finance. 'Market participants of the type found in other financial centres cannot be conjured into being at the stroke of one pen', wrote the Council.

> It would be unrealistic that, simply by writing the appropriate rules, The Stock Exchange can create a dozen auction/specialist Firms in the US mode, accepting complex market functions and capable of making a respectable return on capital. Nor can new competing market-makers be created by edict. Different types of Firm may evolve, but the market framework itself cannot immediately create them (Council of the Stock Exchange, 1984).

The Exchange surveyed the world to identify the structure that would best suit London's history. Through a new fact-finding mission to North America, the Council identified two broad possibilities: a market based on the principle of broker-to-broker auctions, with specialists serving to assist the market process, and a market based on competing market-makers, whose obligation was to provide continuous two-way prices.

Of the different configurations available to the Stock Exchange, there seems to have been an initial, almost nostalgic, appeal for a market driven by specialists. After all, this was the model followed by the New York Stock Exchange, the largest such organisation in the world since the 1920s. 'In London', remarked Hayter, 'we intuitively felt that New York and London were of similar importance, and therefore that we ought to look quite closely at what they'd done. [If you looked] at the domination of the New York Stock Exchange, it was self evidently true that this was the way to go'. Indeed, the Council contemplated 'adopting different trading systems for different categories of securities' allowing specialists to handle the most active shares in the market (Council of the Stock Exchange, 1984). Alas, by July 1984, the Stock Exchange had recognised that New York specialists were losing their importance. The conclusion was clear: '[to] introduce a specialist system with all its faults, on a largely unwilling membership would be to impose the second best at a time when the opportunity to make the right choice existed' (Council of the Stock Exchange, quoted in Michie, 1999). Another American system emerged as the

pattern for London's future. NASDAQ, the automated quotation service of the National Association of Securities Dealers and a direct competitor of the New York Stock Exchange, became the source of inspiration. 'NASDAQ was intriguing', remembered Hayter, 'because [their] market-makers looked a bit like [our] jobbers, except that they were dual capacity, they were able to trade on the one side with their clients and on the other side for themselves'.

With the decision to adopt a competing market-makers system, the contours of Big Bang were settled. It was clear, by then, that changes to the terms of membership would accompany the introduction of negotiated commissions and the end of single capacity. And, to a certain extent, it was also clear that the brave new world would be dominated by larger, better capitalised member firms. 'New dealing systems', wrote the Council in its April 1984 paper, 'will give rise to the need for increased capital in member firms […] The stipulation that a non-member must not own an interest greater than 5% in a Member firm when it already owns 29.9% of another firm [will] be relaxed' (Council of the Stock Exchange, 1984). The Council had opened the floodgate for mergers, allowing brokers and jobbers, merchant and investment banks, British and foreign to mingle. And in preparation for Big Bang, set to take place on 27 October 1986, both domestic and international firms entered a period of courtship, seeking to arrange the corporate marriages for the market of the future.

4.8 The gears of change

The competing market-maker system adopted by the Council involved a shift in the architecture of the market. The Stock Exchange would now have to provide a two-way system for the communication of quotes between brokers and market-makers. As such, the path taken towards Big Bang entailed re-structuring the existing technological platform.

With hindsight, it is tempting to interpret the decision to emulate NASDAQ as the origin of the technological choices taken by the Stock Exchange in the years leading up to Big Bang. However, closer inspection of the events surrounding the

activities of the Exchange in the early 1980s reveals that, by the time the Big Bang approach was announced in 1984, the Technical Services department had already drafted an ambitious plan of technological reform that would serve as the partial blueprint for 1986. The plan was no doubt inspired by NASDAQ, but only as much as it was inspired by the broader developments in the international securities industry as well as the changing technical horizons of computing and telecommunications. The primary rationale behind the system proposed by Technical Services derived mostly from local perceptions on the need to standardise the existing computer and communications services offered by the Exchange. In effect, the plan presented by George Hayter's department envisioned reassembling the heterogeneous network of market information and settlement systems under a single technological umbrella, creating a general-purpose network to replace those in place.

The blueprint for the so-called Integrated Data Network, IDN, originated during the years of uncertainty surrounding the Restrictive Practices Court case and, as most of the efforts of computerisation within the Stock Exchange, came from problems in settlement. As early as 1979, a Joint Committee on Gilt-Edged Settlements (where gilt-edged refers to the government debt issued by the Bank of England and traded in the London Stock Exchange) recommended the development of a 'long term computerised book-entry system for Gilt-Edged settlements' owing to the 'risks currently incurred by Member Firms when settling high value bargains on a next day basis by the movement of physical transfers, certificates and cheques' (Joint Study Group on Computerised Gilt Settlement, 1980). In a system still dominated by paper-based securities, the transfer and settlement of deals presented several risks and difficulties associated to the materiality of documents: from time to time, gilts were lost by the couriers or damaged in transit and, overall, the transfer of checks, cash and paper was a costly part of the transaction, requiring the physical movement of documents across offices in different locations. The system proposed for gilt-edged securities allowed transferring stock ownership and payment for stock 'without need for any paper movement', immobilising paper-based gilts by creating a digital proxy of the market in a computer. The system, based on the concept of Book-Entry Transfer, BET, required the creation of a Central Gilts Office, CGO, that would

maintain uncertified holdings for all principals (for instance, jobbers, money brokers and clients). Terminals would be used to transfer stock and money between principals via their brokers. And all would be linked by a central computer that kept track of the exchange of certificates and money.

From the outset, TALISMAN, the existing Stock Exchange settlement service for company shares, was seen as inadequate for its use in gilt-edged settlement. The central nominee system upon which TALISMAN relied obliged firms to surrender registrations of their shares to the Stock Exchange Pool Nominee, SEPON. This, nevertheless, implied a central liability of payment, deemed 'unacceptable to all parties in view of the values inherent in gilt settlement' (Joint Study Group on Computerised Gilt Settlement, 1980). Although TALISMAN was not adopted as a model, its proven success provided a sound foundation for the CGO, at the least in terms of the trust attached to the Technical Services department of the Stock Exchange. Indeed, Technical Services was given the task of evaluating the proposals of the Joint Committee and was chosen, soon enough, to lead the creation of the system. For Bennett, in particular, this became an opportunity to take real-time computing into settlement. It was, as he mentioned, the moment when he 'got them to think in terms of real-time' (Bennett interview).

By May 1982, the Council of the Stock Exchange had embraced a data network strategy that called for an integrated system for the entire securities industry. A year later, in 1983, the idea of the integrated data network took BET/CGO a step further. In fact, the gilt-edged securities settlement system became but the first stage in the more ambitious development of an Integrated Data Network. As George Hayter announced in 1983, IDN was set to have 'a widespread impact on the working of the Securities Industry over many years'. Based on the growing communications method of packet switching, IDN was a direct response to the 'proliferation of networks' within the Stock Exchange which, in the views of the Technical Services department, had led to 'high cost, inflexibility and inconvenience to service users'. Offering a unique communication platform, IDN would permit the interoperability of the existing systems at the Stock Exchange while providing 'faster, easier and

cheaper communications' for the UK securities industry 'by setting up a common data network operating to a set of recognised international standards' (this paragraph is based on Hayter, 1983).

The packet switching method chosen for IDN resonated with the real-time computing and communications design principles of the Technical Services department of the Stock Exchange. Pioneered in military applications in the United States of America in the early 1960s, packet switching provided a technical basis for engineering large computer and communication systems. With its forward-looking design and its overtly strategic intent, IDN became the flagship project of the Stock Exchange, acknowledging the importance of owning and controlling 'the principal communications facilities used for [business] in order to facilitate [the Stock Exchange's] regulatory control over the market and its Member Firms' (Hayter, 1983). Standardisation meant not only a more fluid and efficient arrangement for the marketplace and the clients of the Stock Exchange; it symbolised control over the market and its participants.

IDN would have been a tremendous technological achievement for the Stock Exchange, had it come to fruition. The system, designed by Bennett and his team, and heralded by Hayter, would have made a cost-efficient use of the most sophisticated systems available at the time. It would have integrated the 'IBM personal computer, or one of its look-alikes [as] the basis for [a new] terminal system'. Brokers, market-makers and clients of all types would have been able to 'use a single terminal, or a limited range of terminals, for a multiplicity of functions'. And through its development and management at the Stock Exchange, IDN would have freed the user from 'the cost and time involved in building and maintaining his own communications networks' (Hayter, 1983). Indeed, the system was visionary: in design, IDN would introduce the modern multi-purpose trading screen to London at a scale not seen before. It ws the veritable foundation for what the Technical Services department saw as the standardised information flows constituting the blood of the market. The financial press clearly identified the strategy of the Stock Exchange. 'Ideally', wrote Alan Cane of the *Financial Times*, 'the Exchange would have liked

to have created a totally new market information and trading system'. But times were difficult, and the deadline of Big Bang loomed above everyone's head. IDN in its complete incarnation would have to wait, if not be completely forgotten. Eventually, only the initial stages of IDN materialised, in the form of a BET/CGO settlement service, based on fault-tolerant, non-stop Tandem computers[3] (Cox interview).

4.9 SEAQ and conquer

IDN did not disappear entirely from the scene. Although the project of a single communications network was sent to the backburners, it remained deeply ingrained in the attitudes of many technologists within the Exchange. Such was the case of Peter Bennett. By late 1984, Bennett had left the Special Systems Group (largely absorbed by the Technical Services department) to start the Advanced Systems Group, a 'directorate [with] a very small team of [hand-picked] people' (Buck interview). In December 1984, and with most in the Exchange acknowledging the unfeasibility of IDN given the deadline of October 1986, Bennett presented his vision of the market of the future. In a document directed at the authorities and members of the Stock Exchange, Bennett warned of the 'danger that the information systems required to maintain and to grow the position of the UK Securities market as a world leader will be developed on an ad hoc and piecemeal basis, leading to fragmentation and low return on investment' (Bennett, 1984). Rather than investing in an entirely new system, however, Bennett saw in the TOPIC/EPIC combination a foundation for the information and trading supports systems of the new marketplace. TOPIC, in particular, could be

> developed extensively to handle the anticipated increased flow of information available from the restructured market, to broaden and add depth to the information available, and to improve ease and use of accessibility to the information banks. The TOPIC system will continue to be marketed to the investment community at large (Bennett, 1984).

[3] Arguably, the choice of Tandem computers over DEC's systems evidenced the different engineering cultures within the Stock Exchange. While settlement relied on batch processing systems and, physically, on IBM and Tandem computers, market information services were built on DEC computers that, in their recollections, allowed systems programmers to deal with the technical minutiae of real-time computing.

In proposing the existing TOPIC and EPIC systems as a technological solution, Bennett sought inspiration abroad. For him and others in the City of London, there were clear indications that the UK securities industry was 'poised to make a massive investment in information technology, particularly in areas of front office automation' (Bennett, 1984). The signals from North America were notable. There, Bennett identified markets based on computer networks as a 'significant trend'. The Computer Assisted Trading System of the Toronto Stock Exchange, along with the National Association Securities Dealers' Automatic Quotation System and the order-matching network of Instinet were among some of the 'significant ripples on the establishment pond which cannot be ignored', wrote Bennett. These systems, however, posed what was then considered a particularly grave risk for the Stock Exchange. 'As the physical floor gives way to screen based and networked markets it is important that [the focal point once occupied by the floor] is not lost, as is happening in the USA, resulting in a fragmentation of the market[4]' (Bennett, 1984). The flaw of the American system, argued Bennett, resided in that the main exchanges across the Atlantic

> have not taken a lead in the development of networked markets, but have instead largely abrogated the responsibility for networking and have handed the business to third party operators. In contrast, the U.K. Stock Exchange has invested, and continues to invest, heavily in information and communications systems and it has built up a considerable systems development and operations skills in these areas (Bennett, 1984).

With this, Bennett established a justification for the growing body of technologists within the organisation: the future of the Stock Exchange was not to be found only in the marketplace and its regulatory structure. Rather, it resided in the discussions taking place in the offices of the Technical Services department. The future of the market was rendered technological.

In Bennett's vision, the core of the ideal market, IDN, was partly a continuation of the service provided through TOPIC, partly the introduction of packet switching in financial services. As an 'open system' (insofar as third parties could add value to it through feeds such as TOPICLINE and the Computer Readable Service),

[4] Here, Bennett was referring to a perceived fragmentation of the American securities market brought about by the emergence of NASDAQ (which operated over-the-counter) and the American Stock Exchange, AMEX, which competed with a well-established and longer-lived New York Stock Exchange.

TOPIC was extremely successful. Hence, the move to a general-purpose IDN could be carried out in a modular, step-wise fashion using existing systems and services. In effect, Bennett presented IDN as a 'set of standardised and versatile networking and information systems building bricks which will be used by the Stock Exchange to build its new generation of networked systems' (Bennett, 1984). The Stock Exchange, wrote Bennett, 'is getting into LEGO business'.

What Technical Services envisioned was the creation of a market infrastructure based on a standardised instruction delivery system, in which personal computers sitting in offices across the world would transform London into a global marketplace. 'Globalisation of the UK securities market', read the December 1984 report, 'could be achieved by linking the UK messaging and packet switched network to other securities and Finance Industry networks' (Bennett, 1984). Full automation on a global scale by means of the creation of a globally accessible order book – a concept never before imagined in London– was the ultimate outcome of IDN.

As a stepping-stone, and notwithstanding its supporters, TOPIC was limited. 'Whilst providing a strong foundation, [TOPIC] would not be a complete solution to all the networking requirements of the securities industry' (Bennett, 1984). The technical limitations of TOPIC were clear:

> [the] network was optimised for the outflow of rapidly changing market information, but it was not an ideal basis on which to build high volume data collection, transaction processing and teleprocessing applications which require two way communications (Bennett, 1984).

TOPIC terminals, furthermore, were inadequate. They did not 'meet the needs of transaction processing applications [or] the market needs for high performance information distribution and display' (Bennett, 1984). Above all, the network composed of TOPIC and EPIC lacked a critical feature for a dual-capacity market, that is, a system for disseminating two way quotations generated by market-makers to the membership at large.

On account of time, the efforts of the Stock Exchange shifted to pragmatics. Big Bang was less than two years away, and implementing an integrated data

network in such short time was, at the very least, risky. For Hayter, there was 'a wide river to be crossed and time only to build a Bailey bridge initially'. The Bailey bridge to which Hayter referred was an interesting metaphorical choice for the strategy adopted by the Technical Services department. Developed during the Second World War by Sir Donald Bailey, a 'Bailey' bridge is a portable, ready-made, standardised, and interchangeable structure that a few 'unskilled' soldiers can erect rapidly across a river or depression during a military operation. Bailey bridges were instrumental innovations during the war, and remain widely used in both civilian and military applications. Yet an important characteristic of these structures is that they are temporary tools for getting things done. For Hayter and others in the technical teams, time was scarce for blue-sky innovation. What they needed was a system delivered on 27 October 1986 for the new marketplace. And it was clear that, however elegant, IDN was not the Bailey bridge to cross the turbulent waters of a market in constant reform.

With hindsight, and paraphrasing Jean-Paul Sartre, the technological bet at the Exchange was placed years before Big Bang with the selection and design of TOPIC and EPIC. The systems had become locked-in (David, 1985). After almost fifteen years of in-house innovation, the Stock Exchange had deployed a vast and heterogeneous array of systems, standards and networks. The very meaning of compatibility and incompatibility had been congealed in the platforms of British finance: not only were the capital investments in the existing systems considerable; member firms, in particular, had built their own systems around the standards of TOPIC, EPIC, and CRS, creating economic, cognitive and organisational expectations that were anchored to the materialities of the Stock Exchange's information and settlement services. Changing the systems for a completely new network, however efficient it may have been, was both financially and socially prohibitive[5]. And so, when the time came to develop a new platform for market exchange, the technical

[5] The considerable social, cognitive and economic costs associated to the replacement of the Stock Exchange's systems (and thus, their *de facto* lock-in) is an important illustration of the organisational centrality of information technologies: the systems of the Stock Exchange were not merely instrumental mechanisms of data communication; they were central elements of inter-firm relations and a critical part of intra-firm practices. Similar claims have been made elsewhere in the literature. See, notably, Kallinikos (2002), Kallinikos (2004) and Orlikowski and Iacono (2001).

and organisational conventions of the past were the prime source of inspiration. In late 1984, as Bennett drew plans for a completely automated financial world (he later recalled that 'everything in [his 1984] report was developed but [in] a very expensive, pedestrian way'; Bennett interview), Hayter presented London's newest bridge. Initially code-named SEMANTIC (for Stock Exchange Market ANd Trade Information Computer) and later known as SEAQ (for Stock Exchange Automated Quotations), the solution implied a modification of TOPIC and EPIC that allowed bidirectional distribution of quotations from either the trading floor or the offices of member firms and their subsequent visualisation in TOPIC[6]. Trades under this system were conducted over the phone or face-to-face, then entered into the SEAQ terminals. The system was 'not exactly rocket science', recalled Buck. All SEAQ was, said Bennett in interview, 'was TOPIC, really. It was it was just TOPIC and EPIC brought together. [The system was] two legacy systems [put] together essentially, which was actually quite a safe route'. Indeed, As Hayter explained in December 1984, in arriving at this choice of design, the Technical Services department

> had to face up to a number of practical problems. Firstly, we have a short time scale in computer developments [which] will not allow us to build radically new services from scratch with any degree of confidence that they will work effectively and reliably under high volumes of loading from the first day of the new market. Secondly we have a fundamental uncertainty about the real requirements of the system. […] Finally we have little idea about the absolute level of trading which is likely to take place and the consequent level of system activity (Hayter, 1984).

SEAQ responded to the constraints faced by the Stock Exchange. It relied on 'solid and reliable systems', tried and tested for several years, and presented a 'low-risk implementation plan'. For technologists like Hayer, Big Bang became a series of 'scarcely discernible pops' (Pagano, 1985).

[6] Ian McLelland recalls that initially there were three system proposals codenamed 'red', 'amber' and 'green'. Upon refinement, these derived into two releases of SEAQ, one 'focused on functionality (a single machine configuration), the second on failover and recovery (a dual or multiple machine configuration)' (McLelland, personal communication).

4.10 The material expansion of a dematerialised market

The effectiveness of SEAQ was tied to the reliability and speed of the TOPIC/EPIC network. Under the old market structure, 'if you're lagging by a few milliseconds or whatever', noted Buck,

> it's really not a big deal, whereas [in SEAQ], they [were] actually dealing off [the system] and so it was really important that [users had] up to date information. [Ideally,] you want [quotes] coming in not from someone just sitting typing stuff in. You want a better capture system (Buck interview).

SEAQ thence entailed changes to the architecture of the networks of the Stock Exchange that would guarantee technical reliability in the marketplace. These changes came in many forms. Some involved upgrading the computers on which the existing network operated. This was carried out by substituting the PDP 11-70 by a VAX, also from Digital Equipment Corporation (with whom the technical teams 'worked very closely […] particularly on the technology changes' [McLelland interview]). Others involved a re-standardisation of the means of communication between the systems operated by firms and those owned by the Stock Exchange, following some of the logic of IDN.

> We specified a protocol for the quotes to come in from the computer and the same with the trades. And [we] went around and convinced the members, who at this point were all busy basically either stabbing one another in the back if not actually sleeping with each other to try and make big conglomerations, what they needed was a dealing system of their own that managed their portfolios, that managed their quotes and their trades, and communicated with us. [Some] of them had started to go along think along those lines anyway. [But] those were just the big companies (Buck interview).

Restructuring the technological marketplace involved negotiating an alignment of the interests of a heterogeneous group of users within the firms. Analysts, hired by the Stock Exchange, bridged the communication channel between the technologists and the potentially thousands of users in the City of London, identifying requirements that became specifications for the systems introduced on Big Bang.

Yet a different type of changes revolved around the design of EPIC's databases. The design principle of real-time computing was reaching a clear expression in the Stock Exchange. The strain exerted on EPIC by the constant influx of quotes and trades submitted through SEAQ meant that the database had to deal with

a larger-than-average number of transactions. The initial proposal was to develop a relational database (much like the ones that live at the core of most of the current information applications). As Buck recalled,

> [The] important thing for us was to have a very fast database. And we looked around all the commercial databases that were available and we'd worked out that we wanted a database that could handle between 5 and 9 transactions a second, ideally more to give us [leeway]. So we talked to [to several vendors], and the new version of Oracle [was] coming out [soon] and they could guarantee on a VAX 80-600 […] an average of a transaction a second, on a good day, with a trailing wind. […] One transaction a second was where it was at (Buck interview).

Peter Buck, who by then was Developer Manager for SEAQ, circumvented the problem by choosing a memory-resident database as the core of the system,

> which was feasible because we didn't actually need that big a database. [There] were 1500 stock that were actually traded, and as far as SEAQ was concerned, the important thing was the quotes that were coming in, the trades that were coming in, just sequences of numbers. […] So we decided to build this, and I did some benchmark tests on it, and I got her going at 1000 transactions a second. It is a little bit more than Oracle. I was very pleased. (Buck interview).

Indeed, the development of the infrastructure for Big Bang depended on the systems programming approach that had defined the engineering cultures of the technical teams of the Stock Exchange since the 1970s. SEAQ involved spending 'a lot of time looking at the heart of the VAX operating system to work out how we could do it in a way that would work' (Buck interview). A similar view was expressed by Ian McLelland:

> We had to write our own drivers, so you had a programmer who was basically writing a device driver, so he had to know how a device worked, [and would have to] work more closely with engineers. It wasn't like doing a client's requirement [and] saying 'well, you know, this is the function that I want', [and] writing it. It was actually getting that in and making that work with, say, our database. So to call them application programmers wasn't quite right.

With their understanding of computing and communications at the level of both programming and engineering, along with the trust cultivated with the Council, the technologists of the Stock Exchange were in a unique position to influence the shape of the market. Their high technical and organisational standing is illustrated by two

cases: the introduction of the first real-time ticker and first real-time index of the Stock Exchange.

Both developments derived from one of the fact-finding missions carried out by the Stock Exchange in the years leading up to Big Bang. In one of these missions, Michael Newman and Daniel Sheridan (who was in charge of market rules and supervision) had the opportunity to visit Wall Street, Washington and Toronto. John Scannell remembers the episode:

> Mick rang me up from, he usually used to do this, about two o'clock in the morning. 'Yes Mick, what do you want?' 'I've got this great idea' 'Yeah, What is it?' 'I'm in NASDAQ in New York' and he said 'I've seen a ticker'. 'So what's a ticker, what the hell is a ticker?' 'It's something that runs at the bottom of the screen, we've got to have one, we must have one' So I said 'who the hell is going to be interesting in a bloody ticker?' And he said, 'well they've got it, everyone's using it, we can have it on TOPIC, we can have a ticker page, we'll run a ticker page'. Well, I said, that's going to take months to get that installed. 'No, what we'll do, we'll get a PC and we'll have the output coming from EPIC into this PC and Ian will write a little programme on it to produce a ticker, then we'll pump it into TOPIC, and we'll have a ticker page'. So he probably rang Ian up and said 'we need this software, how quickly can you do it?' And Ian probably said six months. And Mick would say, 'no I need it in two weeks', and he did it in about two months and got this thing running in the end. [But] right from day one it was a success (Scannell interview).

Visiting North America proved undeniably fruitful. 'Mike [rang me] up again, another time. 'I've got another idea', he said' (Scannell interview). The idea, conjured by Sheridan and Newman during a tour of Niagara Falls following a conference in Toronto, was aimed at making London's traded options market 'a bit more exciting' by introducing index options (Sheridan interview). That, however, required 'an index, a real-time index' on which to trade. The existing FT30, dating to 1935, was 'hopeless because it [was] geometric. It was a very peculiar way of doing it' (Newman interview). Sheridan and Newman created the new index, observing that

> the 500 or 750 [stocks] which the academics decided [had] a high correlation [with] the market [were what we] wanted as a proxy for the Exchange. [It] would actually be impossible to maintain that on a minute by minute basis, so we compromised on 100 (Newman interview).

The result was labelled the Stock Exchange Index, SE100, which was coded in two weeks and ran as an application on EPIC (McLelland, personal communication). The name became somewhat of a political controversy, as Sheridan recalled.

> The Chairman at the time, Sir Nicholas Goodison, called us into his office and said, 'we're not going to do this because we'd upset the [Financial Times]. And notwithstanding they had nothing whatsoever to do with it, he said we were going to call it the FT SE index and that's what we did.

After a trial period of some weeks during which the constituents and weighing of the index were agreed (a process that as McLelland recalled involved several Stock Exchange/Financial Times committee meetings; McLelland, personal communication), the symbol of London as a global city, the ubiquitous number that is the FTSE 100, was born.

Above all, however, the most tangible transformation of the Stock Exchange was the expansion of the technical teams and the networks they worked on. That is, the expansion of the material and organisational support of the marketplace. Reconstituting the market for Big Bang, and embracing the strategic centrality of information systems, led the Stock Exchange to amass a small army of technologists. Around the time of Big Bang, the Stock Exchange employed between 3300 and 3500 people (Sheridan, Bennett interview). The original group of a few dozen technologists that developed TOPIC and EPIC in the 1970s had grown 'to a couple of hundred, three hundred probably' (Buck interview). While Peter Bennett along with a handful of technologists moved into a smaller unit, the Advanced Systems Group, George Hayter, head of Technical Services continued to oversee between 2,000 and 2,200 employees whose responsibility was to 'run the market and [make innovations] operational' (Bennett interview). Programmers, developers, engineers, analysts, managers, marketing specialists and clerks overflowed the original tower of the Stock Exchange, requiring up to 14 buildings distributed across the City of London, housing everything from offices and restaurants to back-up systems in different locations (Scannell interview).

The technological culture of the Stock Exchange was not immune to this expansion.

> As we were getting bigger you needed to split [functions] out to different people. And therefore you needed more formality in the design documents. It's ok if you make some notes for yourself and make a sort of rough-and-ready design document that you're then going to code from, because you understand the assumptions that you've made and what this really means and what does this squiggle over there actually mean. But when you've got different people doing it, it needs to be more structured, more formal (Buck interview).

The Stock Exchange became a tremendously large, and equally complex, developer of information technology. 'We were constantly developing', noted McLelland.

> It was literally while one release were being developed, we got the programmers working on that as soon as we could, the designers would be looking at what are the next stages, and you either had like a major requirement coming or we had what we called change requests which would drive us. Then we said, 'ok, what's the next release going to look like' and start designing that. And we could even have three releases on the go. You know, once we'd got a release into testing whereby we were supporting any fixes that had to be done, we'd probably have a team working on the next release and the designers working on the release after that, so it was kind of like a continuous cycle because this is what the Exchange and its membership demanded (McLelland interview).

4.11 The international testing ground

Although the Stock Exchange and its technologists were confident that SEAQ would serve its function as the Bailey bridge for Big Bang, success relied on the untested dealing method of dual-capacity. However, whereas dual-capacity was prohibited largely to members of the Stock Exchange prior to 1986, the practice thrived in the international market, unbound from the rules and regulations of the Exchange.

As a financial capital, London held a long record of accomplishment in international dealings. Prior to the 1920s, the Stock Exchange had been a hub of international finance, dealing in the shares and bonds of foreign companies and governments. This changed, however, with the growth of the North American stock markets (which overtook London in both size and influence) and, more importantly, with the monetary restrictions imposed in Britain at the outset of the Second World War. In an attempt to disincentive the flight of capital from Britain overseas in the

event of war, the government introduced a mechanism of exchange controls in 1939. By 1941, exchange controls extended beyond payments for the import and export of goods to the movement of gold, currency notes and securities. Exchange controls effectively prevented UK residents from buying non-sterling securities unless through an authorised depositary and, even then, only with the express permission of the Bank of England (Michie, 1999). The difficulty of engaging in international deals was furthered by the so-called dollar premium, introduced in October 1947, and which consisted of an additional fee paid to convert an American price into sterling at the official rate of exchange (Rix, 1950). Such restrictions increased the costs and complexities associated to dealing in foreign securities, restricting the desires and abilities of British investors to enter the international markets.

This situation was not made any easier by either the culture or the rules and regulations of the Stock Exchange. Here, the emergence of the Eurobond market serves as an example. Eurobonds were first introduced as a method of raising capital in the early 1960s. Unlike the typical bond, however, they are issued in a foreign currency. Thus, a bond issued in London and denominated in dollars would constitute a Eurobond. For the City of London, Eurobonds became quite an attractive instrument. Insofar as they were not converted to sterling, they could be traded freely without the restrictions imposed by exchange controls. They hence became a depositary for the foreign capital that entered the City of London and which expanded quickly throughout the 1960s and 1970s. The London Stock Exchange was nevertheless a marginal player in the newborn market. Under the rules of the organisation, notes Michie (1999), commissions on Eurobond dealings had to be paid by both seller and buyer, and the transaction had to pass through a jobber who introduced a further differential between bid and ask. Non-members, particularly foreign investment firms with offices in the City of London that were not members of the Stock Exchange, had no such obligations and could guarantee a lower price per transaction. As a result, Michie (1999) estimates that by 1968 only one per cent of trading in Eurobonds passed through the Stock Exchange. The rulebook, along with an overall hostility to encourage arbitrage dealings and the complacent

insularity of the whole investment community left the Stock Exchange on the sidelines of a growing global financial system (Kynaston, 2002).

The elimination of exchange controls 1979 became a fundamental moment of transformation for London as a financial centre. Compounded with the demise of the Bretton-Woods agreement on fixed exchange rates in 1972, the abolition of exchange controls

> [made] it possible for far more attention to be paid to overseas markets by domestic investors. It forced member firms of the Stock Exchange to think more constructively about overseas markets than they ever had before. It freed capital, and it really was not possible after 1979 for the Stock Exchange restrictions to remain in force if you think about it historically. Other markets abroad, other practitioners abroad, were going to operate under free rules, different rules. So change was inevitable from 1979 onwards (Sir Nicholas Goodison in Kandiah, 1999, p. 104).

International markets were a vast frontier for exploration. And so, when it pondered the possible routes towards Big Bang, the Stock Exchange saw overseas securities as the ideal place to initiate experiments in dual-capacity.

International markets were a frontier in more than one way: they constituted a domain populated by computing and telecommunications technologies and their pioneering applications. The end of fixed exchange rates in 1972 had set the foundations of a market in which currencies could be bought, sold, hedged, arbitraged and mobilised across the globe. Seizing this opportunity, Reuters built the modern foreign exchange market. Reuters' interest in the dissemination of prices originated as early as the 19th century, when it offered a communication service between London and Paris. When Reuters entered the realm of computing, it introduced Stockmaster, a quotation retrieval service, into London. Quotes from the American markets travelled through ticker-tapes and were collected by a computer that transmitted data on demand across the Atlantic to Stockmaster terminals in Great Britain. This eliminated both the load on the expensive transatlantic communication channel as well as the need to 'sort through a bundle of paper and prices before you found the price you wanted' (Lawrenson & Barber, 1986, p. 129). More importantly, with the abolition of exchange controls, the network laid by Reuters became a potential platform for creating a market in both British and overseas securities.

The threat posed by Reuters to the international expansion of the Stock Exchange's operations was clear. As Hayter noted in interview,

> Reuters sensed there was an opportunity for them to move in and be the market in some major respect. In the same way that they had already become the trading mechanism for foreign exchange, they wanted to do the same thing for equities. And the first area that they started in was in was foreign equities that were not listed in London. [..]And so they set up pages that looked a bit like SEAQ, in black and white, on their Reuters monitor screens, company by company, and [in these] you could see all the market-makers quotations. [They] thought 'Well, this is our opportunity to corner, to provide the electronic infrastructure for the foreign securities market in London'.

The Stock Exchange reacted. With a newfound desire to become a financial centre for dealings in international securities, it pursued an aggressive strategy. 'I put Peter Cox in charge of competing with Reuters on this', remembered Hayter, 'and we succeeded in creating a primitive market that actually beat Reuters at their own game' (Hayter interview).

Peter Cox was closely involved in at least three of the Stock Exchange's largest projects. An engineer by training, Cox joined the Stock Exchange seconded from IBM in 1976, where he specialised in expert systems. The technical and organisational knowledge gained by Cox at IBM came to the fore when he was made responsible for outlining the design of the settlement system TALISMAN, which relied on the recently acquired IBM 370/145. For Cox, the development environment for TALISMAN proved to be an interesting, perhaps even formative, experience. The Stock Exchange had

> brought in some new people. They had decided that we were going to do it in a different way. And there was sort of a clean broom that swept through the project. That was extremely exciting, because it had really good people on it. There was a determination to do the thing properly. It was a terrific project. For me, at the time, and for everybody working on it. (Cox interview).

Launched in 1979, 'two weeks later than the plan [because] we were going through some very extensive market testing', TALISMAN was 'very successful' (Cox interview).

The expertise Cox acquired in the development of TALISMAN led him to participate in the joint project between the Bank of England and the Stock Exchange on the gilt-edged securities settlement system, BET/CGO. Towards 1984, and with Big Bang approaching, Cox was 'brought back from the Central Gilts Office project and put into a loose team of planners', reporting to the Deputy Chief Executive, John Young. There, Cox recalled,

> our job was to work out what needed to be done for Big Bang. We came up with a plan which was to create the SEAQ system, […] modelled on NASDAQ but […] based on an information system the Stock Exchange was already running called TOPIC [of which] Bennett was the architect. […] I was actually the only permanent member of this planning team.

Planning for Big Bang required, in a sense, a deep understanding of the market. Working out the 'functionality that would suit the market [was] not a foregone conclusion in those days', said Cox. Indeed, for the members of the planning team (formed, among others, by Michael Newman, Peter Bennett, Peter Cox, and Daniel Sheridan) it was necessary to consider numerous possibilities for the future; at the time there weren't any 'models which [had] been proven in the market, when you design[ed] an electronic market' (Cox interview).

Among the several possibilities available to them, the planning team considered building a pilot market upon the trading platform used and licensed by Instinet. If the system demonstrated to be successful on a small scale, it could be introduced into the market at large in time for Big Bang. The choice of Instinet's platform had a concrete effect on the type of market selected for the trial.

> The idea was that, since we were running Instinet technology and all their expertise were in American securities and [that] there [was a] market in American securities in London, [we should] start a market in [these] running on the Instinet system and then, if successful, roll it out into other markets[,] potentially into the UK equity market (Cox interview).

The trial, however, did not achieve this form. When Cox and his colleagues conducted a preliminary round of market research into the feasibility of the new market, traders in American securities in London dismissed their plans.

> Hardly any of [them] were members of the Stock Exchange. They were almost all big [investment banks], Morgan Stanley, and Shearson Lehman, Merrill Lynch. […] We [told them] 'We have this great idea. We want to

> launch a European time zone market in American shares. You guys are in the business, you're doing it right now, it'll be great. And just sign up being alongside us with this pilot'. And they said 'Oh, that's a stupid idea. You're talking about putting a sophisticated system which runs in the most structured and regulated market in the world out here in Europe, where this American shares market runs with no regulation at all, and nobody has oversight of it. [London is] a bit of a Wild West market. And you want to put all this sophisticated transparent technology in there. Well that's a daft idea, and we're not going to do it' (Cox interview).

The unwillingness of foreign firms to set up shops in association to the Stock Exchange prompted the search of viable options. The one selected by Cox and his team was the 'craziest plan B' they could have conceived: if the prevailing view amongst foreign firms was that the market for American securities was 'a bit of a wild west', a possible solution was to create a regulated and structured market for these and similar securities within London.

The proposal went several steps further from what they did at the time, mentioned Cox.

> [Most] of [the foreign dealers] were saying, 'Well, you know, an organised market is not such a bad idea'. So we said 'Why don't we organise a market in these shares. We don't have to put all the sexy technology in place, but just try to organise a market for these players' (Cox interview).

The market introduced by the Stock Exchange depended not so much on a radical technological innovation or on the adoption of an American trading platform as in a re-evaluation of the social and historical foundations of finance in London. It derived, in particular, from the construction of trust among market participants. Sitting in a large room near the Pall Mall in London, Peter Cox remembered that,

> [In designing the market,] we went right back to first principles. What are stock exchanges? Why are there stock exchanges? Stock exchanges started because these people were buying and selling shares in rooms like this centuries ago [and] suddenly there were rogues amongst them. And the good guys got together and said 'Well we'll form a club of good guys and we'll sign up to a code of conduct that says we're good guys and [when] somebody slips up and doesn't meet the code of conduct, we'll throw him out and that way we'll gain confidence, you know, a market'. And that was exactly the situation we were in with these international dealing guys. They were doing the business but not everybody was quite playing by the rules.

The creation of an orderly market hinged on reaching agreements between the traders, on standardising and regulating their activities. As George Hayter later recalled, these standards were generated by the dealers in conjunction with the Stock Exchange.

> We allowed them to set the rules for how these quotations were to be interpreted. And things like what the standard size would be for the quotations, what currency they should be quoted in, what settlement house would be used for the clearing process. These were not universally accepted, they were not standardised, until we got these people together in a room (Hayter interview).

The market in overseas securities required not only trust and regulation, though. The market lacked a 'uniformity of presentation, [instead] working according to how each individual firm interpreted it' (Cox interview). Uniformity was achieved through the introduction of a single electronic price bulletin board available to all the members of the newly constituted market. And as Cox's team continued to structure and design the new international market in London, they 'went from creating a sort of […] bulletin board to being a market department which regulated the market, wrote the rules, and also created a membership scheme for foreigners' (Cox interview).

The ultimate outcome of this process was SEAQ International, SEAQ-I, an electronic quote-driven trading service that cobbled together several existing systems and, perhaps more importantly, incorporated foreign firms into the operational realm of the Stock Exchange. Eventually, as SEAQ International's market settled and congealed, it became the entry point for foreign firms into the membership of the Stock Exchange. 'When you think about it', said Peter Cox,

> it was a bit of a major step. But again, it was it was small scale stuff when it started. Nobody thought it was really important. The argument we made was 'let's try to get these guys inside and collaborate with us and then we'll gradually reel them in' (Cox interview).

In attracting foreigners, SEAQ International modified the manner in which the Stock Exchange operated, introducing dual-capacity dealings in overseas securities and establishing an undeniable break from the bi-centennial practices of the organisation. (As explored in chapter 6, this break with the past was manifold indeed; the establishment of a market in overseas shares through SEAQ-I required the Stock

Exchange to merge with ISRO, the International Securities Regulatory Organisation, formed by foreign security houses based in London. The merger resulted in a 'very expensive' re-branding of the Stock Exchange [Bennett interview], which became the International Stock Exchange in early 1986). The venture was a wise investment. SEAQ-I became an overwhelming success. As it expanded into a wider variety of overseas shares, it took over a larger segment of the European market. In the late 1980s, SEAQ-I captured between 26% and 60% of the trading in shares of the 250 corporations largest European companies by capitalisation. By 1990, trading in French shares on SEAQ-I represented as much as one forth of the volume of the same type of shares traded on the Paris Bourse (Jacquillat & Gresse, 1998). SEAQ-I 'sucked liquidity from the continental market centres', recalled Bennett (Bennett interview). London became, once again, a competitor in the international arena.

Nevertheless, the success of SEAQ-I was predicated not on its technological constitution, nor on the creation of an allegedly more efficient trading platform (international settlement remained extremely cumbersome and expensive). Although SEAQ-I was a confirmation of a widely held view that 'in the future the business of buying and selling securities is going to be heavily computerised and based upon large scale networks', as Cox wrote in 1985, it did not imply that the future 'therefore lies entirely in the hands of the technologists' (Cox, 1985). SEAQ-I's success lay in the careful weaving of the social fabric of an engineered marketplace, in constructing and making evident the trust and social ties that found market exchange. In effect, for Peter Cox, SEAQ-I demonstrated that in a world increasingly dominated by electronic systems 'traditional' stock exchanges still had a role to play. They exist to create 'confidence in the market place, [allowing] for it to reach its full potential. The future', wrote Cox before Big Bang, 'lies in the successful blending of modern technologies with some of the more customary functions performed by stock exchanges today' (Cox, 1985).

4.12 The dress rehearsal and the ball

The launch of SEAQ International in 1985 was a reflection of the technological prowess of the Stock Exchange when facing the challenges of an increasingly

digitalised financial world. And as Big Bang approached, the work of the Technical Services department increased its pace. To coordinate the different activities and projects, the Stock Exchange created a Projects Committee, chaired by Patrick Mitford-Slade. 'Seven projects were being driven together all with that final deadline' in mind, recalled Mitford-Slade.

> [We] started off by having weekly meetings[,] getting all the leaders of each project [together], the Peter Bennett's, the George Hayter's […] running it all. […] People from all sides of the market were developing their own systems, [and we got] them together once a week to make sure they were not conflicting with each other and were driving at the right sort of speed (Mitford-Slade interview).

Frequent meetings soon gave way to a different approach, leaving much of the managerial decisions to the technologists. The preparation for Big Bang was not entirely constrained to Technical Services. Consultants were hired to audit the ongoing projects. As Peter Cox remembers

> there was some scepticism about the Exchange's ability to bring on the plan, and so we said 'Look, what we'll have is a respected consultancy firm who will have monitors'. They weren't actually project managers, but they'll have monitors sitting on the shoulders of the project managers.

Project managers were, in most cases, the technologists that had brought real-time computing and communications to the Stock Exchange in the mid to late 1970s. As Peter Buck recalled, 'most of the people in that sort of little original SSG group […] stayed at the Stock Exchange and they were the core of this expanding empire. And so essentially we all sort of got promoted together, en masse' (Buck interview).

The version of SEAQ ultimately released for Big Bang was a compromise between the old and the new. On the one hand, the system relied on the tried and tested TOPIC and EPIC. While EPIC provided disk storage for the main SEAQ system, holding backup data and feeding start-of-day information into it, with its reliability record of 35 minutes downtime per month, TOPIC provided the information from SEAQ to the users in the market (Anonymous, 1986c). On the other hand, SEAQ introduced a different modality of trading in the Stock Exchange, providing a platform for dual-capacity dealing through the telephone. In a sense, SEAQ was but a real-time quote entry and visualisation system built upon established technologies, an

incremental technical innovation of sorts, predicated upon radical organisational change.

Under SEAQ, competing market-makers (formerly jobbers) were required to keep continuous quotes for the securities in which they traded. Rather than being uttered on the floor, these quotes were entered into SEAQ terminals. Upon seeing a satisfactory quote on the screen, a broker would phone a jobber to close the deal (and, preserving the logic of *Dictum Meum Pactum*, market-makers could not modify their quotes once their phones rang). Such mode of operation entailed changes to the market and its infrastructure. As occurred with the introduction of EPIC in the late 1970, shares were categorised into different groups (though unlike EPIC, the definitions were now much more explicit). The organisation of the market was given not only by industrial groups but also by turnover, capitalization, and the number of market-makers in each share. In particular, the newly formed Quality of Markets Unit of the Stock Exchange had identified four categories, and to each corresponded a specific behaviour that market-makers were to follow. Alpha shares, for instance, represented the most actively traded equities, accounting for an estimated 56% of the UK equity market. For a share to be considered alpha, ten or more market-makers had to deal in it, turnover had to be in excess of £195 million in the first half of 1986, and capitalization had to be above £740 million as of 30 June 1986 (Quality of Markets Unit, 1986b). For these shares, market makers were obliged to provide continuous, two-way prices during the mandatory trading hours between 8:30 and 16:30, and (initially) details of all trades were immediately published on SEAQ. Beta shares were somewhat less actively traded, and although market-makers in these were also required to display continuous, firm quotes, details of trades were published the following business day in the Stock Exchange Daily Official List. Gamma shares required market-makers to produce only indicative two-way prices, and due to their low turnover, delta equities only entailed displaying mid-prices.

The new categorisation reformatted the market in ways that made it amenable to SEAQ. Importantly, it enabled a new mode of market visualisation that formed an integral part of the electronics-based competing market-maker system adopted by the

Stock Exchange. On SEAQ, each alpha and beta share received a page of its own, displaying the available quotes along with the sizes in which market-makers were willing to deal. Above the quotes displayed on the screen stood the yellow strip, highlighting the best bid and offer in the market (the 'touch' in jobbing parlance). And at the bottom of the screen was the New York-style 'ticker' pioneered by Newman, as seen in Figure 4.3. The yellow strip, in particular, effectively made it unnecessary to walk between pitches in pursuit of the best price. It was a symbolic reduction of space and time, presenting the market in a single line of characters. Hence, the screens produced by SEAQ and displayed through TOPIC made supply and demand evident, tangible, and equally accessible, to all participants in the market. They constituted scoping systems to the London equities market, namely, 'a system of observation and projection that assembles on one surface dispersed and diverse activities, interpretations and representations which in turn orient and constrain the response of an audience' (Knorr Cetina & Preda, 2007, p. 126).

Novel categories were not restricted to shares. In the logic of SEAQ, the market was no longer composed of familiar faces with familiar names. Although the floor remained a trading venue in principle, dealing between offices was considered the norm of the future. Counterparties in SEAQ were firms, represented online by three or four characters next to their quotes. Making the transition even more complex, the larger firms operating after Big Bang were conglomerates bearing new names. The future, so to say, was partially anonymous.

The complications related to the re-categorisation of the participants in the market were unveiled in the immediate weeks before Big Bang, when the Stock Exchange conducted a series of tests of both its technological platforms and the humans working with and behind them. The first such test occurred in the last Saturday of September 1986, when the Stock Exchange held a dress rehearsal for the gilt-edged securities market. Twenty-seven firms participated in the test, simulating normal trade during two hours, based on a make-believe portfolio engineered by the Bank of England. The success of the event provided a 'huge sigh of relief', showing

that under normal conditions both the settlement system and the dealing service could operate with ‘no major computer failure or problems’ (Anonymous, 1986a).

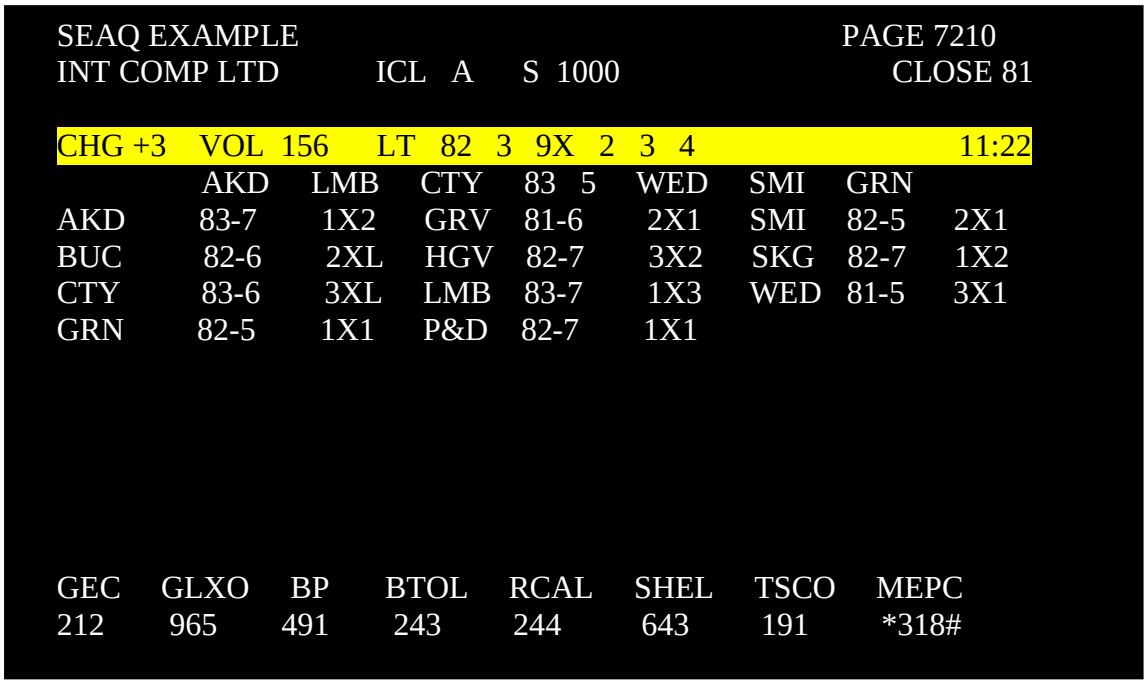


Figure 4.3 This page (taken from Hamilton, 1986) shows the different bids and offers for share 7210 of International Company Ltd (abbreviated as ICL). On the second line, the letter ‘A’ next to ICL denotes that an announcement has been made; ‘S 1000’ indicates the number of shares that comprise a lot; and ‘CLOSE 81’ is the price at the close of business on the previous trading day. The third line functions as a ticker: ‘CHG +3’ stands for the change in the mid-price since the previous night’s close; ‘VOL 156’ represents the volume of lots traded so far; LT stands for ‘Last Trades’, and displays the prices of those trades: 82, 83, 89X (amount in excess of 25,000 share), 82, 83 and 84. The fourth line shows the distribution of quotes among traders and thus the so-called ‘touch’ (the best bid and cheapest offer): 83, bid by CTY and 85, offered by WED. Lines 5 to 8 represent the specific quotes of the 11 market-makers in ICL. The numbers ‘83-7’ represent bid-offer pairs (that is, bid at 83, offer at 87). The quantities ‘1X2’ represent the sizes of those quotes: bid for 1000 and offer for 2000). In cases where a market is made in more than 9000 shares, the letter L is uses, as in ‘2XL’. The final two lines were proposed as a NYSE-style ticker in other shares.

The same cannot be said, however, of the largest dress rehearsal, organised by the Stock Exchange on 18 October 1986. The simulation was ‘designed to resemble a normal trading day as closely as possible’, noted Richard Lander of *The Times*. Institutional investors and brokers ‘will be in their offices to telephone their orders to market-makers, each of whom was given an equity “book” averaging £14 million to begin with’ (Lander, 1986). The participating firms ‘were working to a script’ (Mitford-Slade interview). Reality, however, departed from the ideal. The

brokers and market-makers had to learn to navigate through the system under their new identities. John Scannell recalled some of the difficulties faced on that day.

> [Some firms had] changed their name, and on the dress rehearsal day I had about 21 computer operators working for me and about 15 or 20 people on the helpdesk. [On that Saturday,] people were ringing up saying 'I don't know who I am'. So, you'd say, 'Right, ok, that's your problem'. [And they would answer] 'Yeah, I don't have any idea of who I am'. So I would say, 'Right, who were you, before?' 'Well, I was Wedd Durlacher but I don't know who I am now, so do you know who I am now?' Bizarre conversation! So I just sort of [asked around], 'Does anyone know what Wedd Durlacher is called now?' And so, 'they're called KAS or something like that'. 'Right, you're KAS now'. 'No, I can't be KAS'. 'Why not?' 'Because he's KAS.' 'Who's he?' 'The guy who's [on the other side]'. And it was just so funny. I'll never forget that. Absolute mayhem, it really was.

The introduction of a new method of communication required working out a new conventionality of conversational exchanges in the form of a standardised telephone dialogue which 'had to be concise and to the point […] i.e. 'firm Name, take your bid/offer of volume at price' and not 'hello this is Joe, who's that?' (McLelland, personal communication). Indeed, the problems were not confined to people 'following their script'. Early on, some of the firms failed to get their computers to log-on to SEAQ; some traders claimed they could not contact counterparties over the telephone; and yet others said that, in a breach of the Exchange's rules, some were not even answering calls (Truell, 1986). The main complaint, however, was on the delay between the time market-makers entered prices and the quotes appearing on the screen, sometimes as much as 20 minutes. This, argued *The Times*, led dealers to refusing answering their telephones: trading on outdated prices could, in some instances, translate into losses (Clark & Thomson, 1986). Yet despite mishaps and 32 problems reported by partaking brokers and dealers, most of the faults derived from compatibility issues between the systems of firms and those of the Stock Exchange, so argued the Exchange. 'There were some problems, but nothing really serious', said Mitford-Slade at a news conference following the rehearsal. 'The system has performed exactly as expected', he added.

As the day of Big Bang approached, uncertainty remained in the air. *Computer Weekly* noted with caution that most of the firms would 'go live with partial and patched systems' (Anonymous, 1986d). Michael Newman, SEAQ's

development director, was nevertheless confident the system would manage 80,000 trades a day, well beyond the Exchange's record. SEAQ, Newman said, was 'rock solid' (Anonymous, 1986b). In effect, in the week leading up to Big Bang, member firms were challenged to adopt, perhaps at great cost, the terminals developed by the Stock Exchange in order to reduce problems of compatibility and communication. But time was short and overheads were large. In preparation for the day, the two duplicated operations rooms of the Stock Exchange, one in the Tower and one in an unmarked building on Christopher Street, were turned into 'emergency rooms should the City go berserk' (Brown, 1986). And as the eyes of the City focused on SEAQ on the eve of Big Bang, Sir Nicholas Goodison confidently assured that one thing was certain, 'screen-based dealing is here to stay' (Goodison, 1986a).

Despite expectations, it was not SEAQ but TOPIC that crashed on the big day. Just as business was about to start on the morning of 27 October 1986, trading on SEAQ was suspended and did not resume for 50 minutes. While the system was down, dealers reverted to face-to-face trading on the floor and through the telephone. The event became the news of the day. 'Instead of high technology taking over completely', reported Nicholas Owen of ITN, 'books and pencils were still required, the computer age having not arrived quite on schedule' (ITN News, aired 27 October 1986).

The possibility of TOPIC's failure, however, was not unexpected. Peter Bennett remembers raising the issue before Big Bang. 'I'd written any number of memos on this and given them the actual calculations, and I knew [it] was going to work out a problem on day one. They had about half the capacity they needed' (Bennett interview). In effect, many 'weren't convinced that [TOPIC's MODCOMPs] were going to handle traffic, because we knew exactly what would happen' (Buck interview). On the morning of Big Bang, TOPIC, initially tested to up to 4.5 million page requests, was overloaded with a 'tidal wave' from users. John Scannell, who was then standing in one of the operations rooms, recalled.

> Eight o'clock comes and the systems all come up. And we're looking at the page response request and it goes up to 1.7 million almost immediately, which is a little bit bloody worrying. Then it crept up to sort of two million,

> three million, and four million. What's going on? This is quarter past eight. Then it got to five million, then everything is going berserk. Bells, and whistling, and ringing, and popping and banging.

It took some clever on-site programming, a re-start of the system, and bringing the gilts-edged market offline to establish order in the general market. Dealers in the gilt-edged market were not amused. 'It's the government's market, you can't take it off the system', they said. 'But we said 'You've been dealing perfectly satisfactorily without the system for god knows how many years, you can continue without it for a little bit longer' and of course they did, to satisfaction' (Mitford-Slade interview). As the day came to a close, the Chairman of the Stock Exchange reflected on Big Bang. 'The fact that the system worked at all this morning was a triumph', said Sir Nicholas Goodison (Clark & Thomson, 1986). As the days followed, normality kicked in. Glitches continued to surface from time to time, but SEAQ remained the core of the market and did so for years to come. 'So much for being a Bailey bridge. It was still there some years later' (Buck interview).

4.13 Disenchantment and exodus

The first casualty of Big Bang was face-to-face dealing in bonds and equities on the floor of the Stock Exchange. The hexagonal pitches introduced with the redevelopment of the building in the late 1960s were abandoned three months after the beginning of the new regime. For some, particularly the technologists, this was an expected and ultimately desirable consequence of the introduction of SEAQ. Since real-time data on the supply and demand for most of the shares in the market would be readily available through TOPIC, there existed no reason, so said their argument, to remain on the floor. The demise would be imminent and swift. Others, such as Mitford-Slade, saw the floor as a temporary element that 'might become obsolete, although many Market Makers would still want to make use of it at first, at least until information systems were bedded down' (Mitford-Slade quoted in Kynaston, 2002, p. 646). Indeed, observing the vast expenditures on technology incurred by firms in preparation for Big Bang, George Hayter encouraged them 'to think in terms of a three-year life for trading equities and gilts' on the floor (Hayter quoted in Kynaston, 2002, p. 690). Yet for some of the users, the break in tradition was far too radical. The floor provided a mode of dealing thought to be incommensurable and superior to

the screen. Under pressure from jobbers, the Stock Exchange invested heavily on the floor in the lead up to Big Bang (£2 million pounds, according to Mitford-Slade, who recalled that the floor had to be redesigned with 'screens facing two ways so that everyone was being kept informed'). By September 1986, twenty-eight market makers had signed up for a pitch, with Smith New Court 'making particularly trenchant noises about keeping at least four dozen dealers on the floor' (Kynaston, 2002). Within days of Big Bang, however,

> some [market-makers] had gone, and within three or four months even [those who pushed for it] had gone because they'd realised that business wasn't on the floor […]And it moved very fast off the floor (Mitford-Slade interview).

In March 1987, only traded options remained on floor of the Stock Exchange, with dealings in equities and gilt-edged securities conducted entirely over the telephone and through SEAQ. 'In terms of physical markets', said Luke Glass, spokesperson of the Stock Exchange to *The New York Times*, 'it's the end of an era in London' (The New York Times, 1987).

It would be all too easy to attribute the end of dealing on the floor solely to the introduction of SEAQ. In effect, as Mitford-Slade mentioned, 'when all these prices were being shown to [the brokers on TOPIC] they could ring up the jobber making the best price and transact the business there and then' (Mitford-Slade interview). The floor seemed to have been made irrelevant. Nevertheless, SEAQ was poor at capturing the levels of activity formerly perceived by brokers and jobbers on the floor. It did not reflect, for instance, experiential sensations of sound that provided market participants with a 'feeling' of the state of the market. Here, the solution came again from the technologists, in particular, from Michael Newman. As he explained in interview,

> I conceived […] a proxy view of the market on a screen. How do we do this? I came up with the idea that if we got the top 100 stocks [that formed FTSE] and jammed them on to one page, then that would be a proxy. If you're not on the floor, and you can see what's going on in the main stocks, that page would be a proxy for you. Now, how do you do that? A static view would not tell you the dynamics of the floor behaviour. So it's no good just seeing the prices. What we came up with was a scheme we inherited from Teletext in which you could pulse signals, so that if a stock price had gone down, the price was shown on a red background, and it stayed like that for ten seconds and then went back to 'steady'. So as it changed, it lit up in red or blue, a bit

> like red and blue lights going on. And it stayed like this, so that if you kept seeing flashes, red or blue, you knew that the thing was damn active, and the more you saw changing, the more active it was. So if you saw the whole wretched hundred in changing colour you knew that there was mayhem, absolutely chaos. The other thing you could see by eye was that if you saw nearly everything red, you knew the floor was bombing out. If you saw everything blue, you knew it was all going up. [So] you got this feeling of what it was like. I designed [this page and] called it the trigger page, because the idea was that it would trigger you to go and look [the shares] up in [TOPIC]. The trigger page […] became the most popular we'd ever had.

In effect, the trigger page served as a higher representation of the system-as-a-whole, a 'surprise trigger' allowing 'events of interest to swim into view' (Knorr Cetina et al., 2007). As Newman added, the trigger page was instrumental in facilitating the end of the floor.

> I was told this by one of the dealers I knew quite well when I visited him on the floor in the first or second day post Big Bang. He said 'Christ all mighty! By the time I wander round the floor and find out the prices, they all know it in the office. They are ahead of me!' When he said to me 'they are ahead of me in the office', in living memory, this had never happened before. I knew that the days were up for the floor.

Just as FTSE became the representation of the general state of the market, the trigger page became a handy representation of the floor.

The type of anonymity conferred by the new dealing system proved a difficult creature to manage. In effect, the move to the screen did not entail a complete dissolution of the long-standing social ties that had characterised life on the floor of the Stock Exchange. Nowhere is this clearer than in the development of SAEF, the SEAQ Automated Execution Facility. SAEF followed considerably the logic set by the Technical Services department in planning IDN in the early 1980s. As Big Bang approached and IDN became unfeasible, plans for the future shifted to concrete short-term solutions. Among these, the Stock Exchange considered developing an automatic execution system, part of the successor of SEAQ code-named MANTIS for MArket aNd Trading Information System. MANTIS, expected to 'perform the same functions as SEAQ and a number of others besides', was based on the assumption that

> for slightly less active securities or the slightly larger trades in the active securities, a powerful tool would be the facility to bid or offer a line of stock from your own trading terminal to all other parties who may be interested,

> and to give them the opportunity to accept your bid or offer on the computer (Hayter, 1984).

Hayter envisioned a market where trades in small sizes could be fully automated through electronic order books while 'direct face-to-face or telephone dealing [remained] the rule for the very large trades' (Hayter, 1984). The technological lock-in of SEAQ, however, made MANTIS an unattainable goal. (Firms had incurred in considerable investments on systems compatible with SEAQ and therefore considered departures from the system politically and financially unacceptable). SAEF emerged as a compromise, configured as an add-on to SEAQ.

Figure 4.4 Trigger page. Courtesy of John Scannell

The development of SAEF, however, was plagued by delays – 'their project disciplines and the timescales they needed to implement it were far too long' recalled Nic Stuchfield (Stuchfield interview). Initially planned for introduction in 1987, SAEF was eventually rolled out in early 1989, with market-makers BZW and Kleinwort Grieveson providing similar and highly competitive services earlier in the game. SAEF, however, came with an interesting peculiarity. The service allowed brokers to route their orders to a preferred market-maker (McLelland interview). As Stuchfield, former jobber for BZW, recalled

> once SEAQ was introduced, we knew immediately what the best price was because it was up there on the screen. And we may not make [it]. But there were an awful lot of retail brokers that would rather deal with Wedd Durlacher or BZW as it was now called, or Smith Brothers, or one or two other firms, rather than all these brand new 25 market making firms they had no relationship with whatsoever, and didn't even now how to get a hold of them.

The system, in a sense, automated established structures of trust. Although it keep to best-execution policies, SAEF allowed constraining business as much as possible to 'friends, [people and firms] they knew. And very often you could get a better price on the telephone than you saw on the yellow strip' (Hayter interview).

Indeed, the politics of asymmetric information were not confined to SAEF. The screen simply could not provide the same type of interpersonal visual cues once used on the floor. As Hayter mentioned,

> The crunch [of SEAQ] was that jobbers had to commit a price to the screen. And they didn't like that, because they said 'well, my price depends on who I am asked to deal with. If I deal with the spivvy, if I'm asked by the spivvy broker what the price is, I'll give him a wider one than if I'm dealing with XYZ over here (Hayter interview).

The years following Big Bang thus saw a dwindling of confidence in SEAQ. Market-makers in particular considered the transparency dictated by SEAQ and the Stock Exchange's regulations as forcing them to 'deal in very unprofitable terms with rivals' (Anonymous, 1989). Market-makers could not hide big trades from the rest of the market and were thus unable to unwind their positions as they had done so in the past. Such was the asymmetry introduced by SEAQ that BZW and Philips & Drew, two of the larges participants of the London equities markets, opted out of the system in 1989. Brokers were not immune to the new order either. Encouraged by a widely held assumption that market-makers were unable to execute large transactions, institutional investors with access to the prices in SEAQ circumvented the market and dealt between themselves, leaving the brokers without their commissions. The age of electronic dealing emerged as a particularly hostile place for some of the old Stock Exchange's broking firms.

The cumbersome development of SAEF and the mounting criticisms to SEAQ were a sign of the changing landscape of finance in London and of impending

difficulties for the Stock Exchange. The technological build-up of member firms (discussed in chapter 5), along with increased domestic and international competition, led the Stock Exchange to a precarious situation in the late 1980s. The technologists, however, continued to pursue ever more sophisticated systems that provided faster, more efficient information flows. While Hayter developed SAEF, others advanced projects that resounded with the ambitions of IDN. Peter Giles, who originally worked on EPIC, was looking into a satellite-based replacement for the communications network of the Stock Exchange called SuperTicker (Buck interview; indeed, Bennett had previously sought a similar path when he devised a method for transmitting London prices through CNN's satellite network. 'Unfortunately', said Hayter in interview, 'Ted Turner didn't see the commercial logic of it'). Peter Bennett, on the other hand, worked with Peter Harris on the development of a front office automation system, ORBIT, experimenting with local area networks, window-based working environments, and personal computers (the system, incidentally, was later sold to IBM; Harris interview, Bennett interview). Others worked on Artificial Intelligence applications to market surveillance. And on settlement, the Stock Exchange was venturing into the troubled waters of complete (certificate-based securities) dematerialisation through the development of TAURUS[7]. 'The IT people', recalled Bennett, 'were effectively setting policy. And, like it or not, around Big Bang time it was working very well. It was a bull market, everyone was onwards and upwards, the old member firms were cashing out, new member firms were coming in'. For George Hayter, this route was necessary for guaranteeing the survival of the Stock Exchange. 'I regarded the whole thing very early on as an information business. And if you wanted it to succeed, you had to grow it, and to do it commercially' (Hayter interview). The technologist's command was not merely one of designing systems and outlining business strategies: the analysts, programmers, systems engineers and other members of the technical services staff represented the

[7] TAURUS, which stands for Transfer and Automated Registration of Uncertified Stock, was an ambitious settlement system set to replace TALISMAN. In design, TAURUS was supposed to eliminate the need paper-based certificates by introducing a completely electronic database of corporate ownership, allowing settlement to be carried out in a quicker and less expensive manner. The project, however, ran astray when conflicting interests among stakeholders pressured the Stock Exchange to follow risky technological and organisational routes. The episode, described in (Drummond, 1996), ended with the intervention of the Bank of England, which coordinated the development of an entirely new settlement system, CREST.

largest segment of the Stock Exchange's employees, hovering above 2000 workers out of a total of 3000 (Bennett interview; Scannell, personal communication).

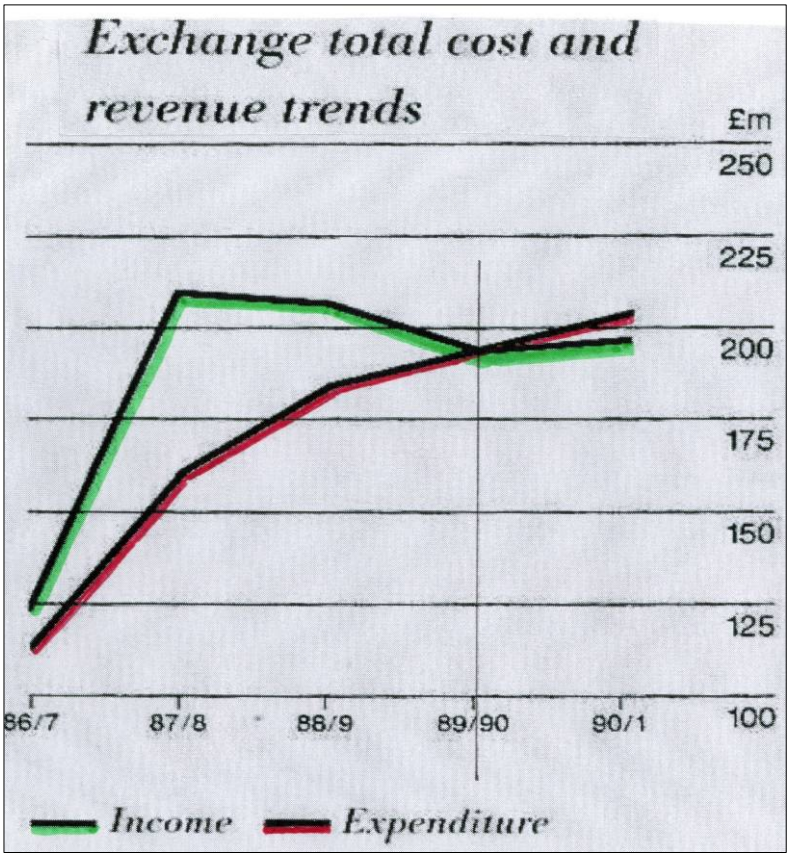


Figure 4.5 Stock Exchange expenditure v.s income in the years following Big Bang. Image courtesy of John Scannell.

The Stock Exchange, however, was no longer the organisation they encountered in the 1970s. The membership, on the one hand, had changed to include foreign firms who eventually obtained representation in the Council. For the newcomers, the business strategy of the Stock Exchange was not entirely clear, recalled Bennett.

> The Europeans were sort of ambivalent, really. But [opposition to systems development came] mainly [from] the Americans. 'This is not the way to run an Exchange. We need to concentrate on other things, like designing a bigger and better market' (Bennett interview).

Indeed, there seems to have been a growing discontent on the way the Stock Exchange set plans for the future. Yet the position of Technical Services was somewhat secure: their systems continued to produce profits for the organisation, as they had since the days of MPDS. The crash of October 1987 and the ensuing

reorganisation of the securities industry, however, marked the beginning of the decline of their relative authority. While expenditure continued to increase monotonically from 1986 onwards, income started to fall slowly in 1987. And in late 1989, the Stock Exchange incurred a loss (see Figure 4.5).

The engineering culture of the Stock Exchange was not immune to the transformations of Big Bang. The Bailey bridge, recalled McLelland, became the cornerstone of future systems rather than the interim solution it had been intended as. 'New systems would not be developed, we would build on the existing limited capability due to time pressure (e.g. SAEF – 'a must have because the US has [the Small Order Execution System])' (McLelland, personal communication). The growth of the technical staff also presented problems: 'Developers were now spending much more time in meetings, project office updating, reporting and all the bureaucracy of big organisations' (McLelland, personal communication). And, in sum, the rapid development culture of the Stock Exchange was 'lost'. 'Developers were no longer allowed to develop without a long process of approval. For many, including myself, it was time to move on' (McLelland, personal communication).

A turning point in this story came, according to most of the original technologists, with the selection of Peter Rawlings to the recently created position of Chief Executive of the Stock Exchange. The developments that followed are murky and soaked in the politics of a rapidly changing and increasingly controversial organisation. The *coup de grace*, however, came in 1990. With mounting pressures from member firms, the spiralling cost of TAURUS, and the continuing influence of technologists on the Stock Exchange's policies, Rawlings commenced a two-year process of outsourcing. 'In a funny way', reminisced Hayter in 2007

> the Big Bang which everybody said was going to rid us of the club mentality and make the whole thing more commercial ended up coming full circle to the point where the members were saying 'We don't want the Stock Exchange to do commercial things. We want it to just be the place that coordinates the regulation of the market, and not very much else' (Hayter interview).

The ranks of the Technical Services department were slowly depleted. And in April 1992, *The Times* reported that an agreement was reached between the Stock

Exchange and Arthur Andersen whereby Andersen would 'run the exchange's market support systems' and take on the '312 exchange staff' (Anonymous, 1992). The exodus began, and soon enough the original members of the Special Systems Group had left.

4.14 A technological epilogue

The paths followed by the technologists after their departure from the Stock Exchange varied greatly. Peter Buck, one of the first to leave after becoming 'very concerned about the way things were going' (Buck interview), joined a small consultancy firm in late 1989. George Hayter, perhaps the most prominent figure of the team to be 'chopped', left a year later, in December 1990 – '[If] you're going to outsource to Arthur Andersen, you don't need a director who's responsible for internal IT services', he recalled – going off to 'develop stock exchanges in Eastern Europe' (Hayter interview). Peter Bennett departed in 1990 too and, for a time, earned 'his bread and butter' by convincing 'the top exchanges in Europe to agree that there was a need for a European price dissemination system' (Bennett interview). (Alas, the system known as Euroquote failed to materialise and was abandoned in mid-1991). Ian McLelland 'moved away from the Exchange, merrily into [the London Traded Options Market] and then over to [London International Financial Futures Exchange]' (McLelland interview). Michael Newman also joined the world of consultancy. John Scannell left in 1992, when Technical Services was outsourced to Arthur Andersen. And, in 1993, Peter Cox joined the London Securities and Derivatives Exchange, OMLX, set up in 1990 to trade options and futures in Swedish securities.

But this was not the end of the story; it was merely a point in a longer trajectory. The years spent building the platforms for the market, negotiating arrangements with jobbers and brokers, analysing systems specifications, planning for the future, creating regulations, and dealing with the institutional structures of the Stock Exchange and the financial world at large were sources of particular forms of experience for the technologists of the Stock Exchange. Navigating through the organisational politics and technological requirements of the market necessitated, in

the words of sociologist John Law, practicing heterogeneous engineering (Law, 1987), arranging things both human and non-human in the marketplace. In effect, the technologists who built the platforms of the Stock Exchange, the George Hayter's and Peter Bennett's of the world, in the words of Patrick Mitford-Slade, possessed not only contributory *technical* expertise (that is, the ability to create new forms of technical knowledge and technical practices through the design of systems). In a much more fundamental manner, they also possessed a unique understanding of the market and an ability to communicate with those who comprised the marketplace. They had, paraphrasing sociologist Harry Collins and Robert Evans (2002), interactive *market* expertise, gained through years of living in and around the marketplace and tempered through the careful elaboration of the materialities that underpin it.

In their diaspora, some of the technologists put into practice the knowledge produced during their tenure at the Stock Exchange. In 1993, after spending a couple of years as an independent consultant, Peter Bennett created an order-driven electronic dealing system for international shares in collaboration with two former Stock Exchange colleagues, Michael Waller-Bridge and Stephen Wilson. This initial group expanded with the incorporation of some known individuals, Ian McLelland and John Scannell. The system, named Tradepoint, was a David for the Stock Exchange's Goliath, the quote-driven SEAQ International. Confidence in the team and their strategy, however, was great enough to attract a number of important firms to the new system (Stuchfield recalled in interview 'the Exchange had a long track record of having visionary heads of technology'). Founding supporters of Tradepoint included BZW, one of the largest firms in London, as well as Goldman Sachs and Scottish Widows. And by 1995, Cazenove, Panmure Gordon, NatWest Markets and Hoare Govett had signed up to Tradepoint as brokers. Tradepoint went online on 21 September 1995, in what The Scotsman qualified as a quiet debut. '600,000 shares worth £2.3 million' were traded on that day, wrote The Scotsman, 'compared with 700 million shares of the Stock Exchange's SEAQ system' (Anonymous, 1995).

The consequences of Tradepoint were not nearly as quiet as its debut. The first domestic competition of the Stock Exchange in 200 years (Economist, 1995) demonstrated that the stock exchanges of the future were based on the provision of liquidity and best execution; they were, in a sense, facilitators of real-time information flows. The pressure was great on the London Stock Exchange. In a world in which marketplaces were freely interchangeable services, structures of membership and their associated dues were an uncompetitive anachronism. In 2000, in the context of a particularly intense period of mergers between exchanges within Continental Europe and across the Atlantic, the London Stock Exchange demutualised: membership was converted into shares, publicly traded in the market. The Stock Exchange was a business, no longer a club. A long road that started with mutualisation in 1947, and which led the Stock Exchange to develop its own systems, computerise the market, and hire an army of technologists, had come to an end. Through Tradepoint and other expressions of technological diaspora, the expertise so intrinsically associated to the creation of the materialities of the market had forever changed the face of finance.

disintermediation

5 Breaking Up the Family: a Social History of Technology and Disintermediation in the City of London

'The changes that have taken place in finance', argued Sir Nicholas Goodison eight years after Big Bang, 'have not undermined the need for a tremendous skill in handling business'. Speaking from his experience as both broker and Chairman of the London Stock Exchange, Goodison's appraisal responded to a growing interpretation of global finance as a sphere of rapid change, a realm of technological depersonalisation, an area of institutional mechanisation. Unlike those who spelled the demise of geography and the triumph of information, Goodison saw continuities in his recent history. Indeed, for him, 'all that's happened after all is that there has been a technological improvement in the display of information, both before trade and after trade, and a huge improvement in the telephone network throughout the world. That's all that's happened. And the skills of the trader, the skills of the intermediary in doing the business are as necessary as ever. They're simply using different tools and better information' (BL/NLSC/C408/09, 1995). For Goodison, finance was the same in 1994 as it had been in years past. It was a personal affair. It was inevitably intermediated.

Across the Atlantic, these words were received as echoes of a distant past, clashing with the sociotechnical futures hailed by commentators and market participants alike. Within the growing cultural circuits of capital – a term coined by sociologist Nigel Thrift to describe the international system of production and distribution of business and managerial knowledge (Thrift, 2005) – 'simple tools' and 'better information' possessed a revolutionary tone. For consultants, software engineers, management professionals, economists and other specialists of finance, the 'technological improvements' that populated the securities industry in the 1980s were the foundation of a historical discontinuity. In the brave new world of digital technologies, large institutional investors could obtain the speed, mobility and opportunities for diversification that they desired; the could find, in the words of the

Office of Technology Assessment of the U.S. Congress, 'more freedom from the clock than the traditional exchange trading hours and floor mechanisms can accommodate' (U.S.Congress, 1990, p. 79). Finance was now free from the chains of time and space. And fundamentally, it was free from the paradigmatic intermediary of yore, the stock exchange.

The imagined futures of finance of the late 1980s and early 1990s were as much a consequence of the desires of large institutional investors to reduce transaction costs as they were the reflection of a deeper change in our shared understanding of social, political and economic life. As mentioned previously, during the 1980s, we were told to think of modernity in terms of a new (technological) economy, to understand life as occurring in a world driven by the production, control and dissemination of information (e.g. Bell, 1973; Bell, 1977; Castells, 2000c).

The rise of the discourse of the information age was particularly noticeable in finance. Emphasis on the affordances of new technologies (Gibson, 1977; Norman, 1999) and the apparent informatic reducibility of life resulted in three foundational myths, one of which maintained that markets could be 'dematerialised': if markets are driven solely by information and rational calculation, then data processing and telecommunication technologies were the natural stage for performing the economies of the future. By utilising these technologies, one could eliminate the clunky analog systems of exchange, communication and interaction of old-style finance, reducing the vastness of the trading floor to the smallness of a computer and an (invisible) network of data feeds. Avoiding the awkward physicality of the material varieties of finance, dematerialised markets are constrained neither by place nor by time. They can operate from anywhere and at any time, executing orders automatically, cheaply and efficiently.

But if markets are amenable to dematerialisation, they are also the subjects of disintermediation, a second myth of finance in the information age. Often presented as the outcome of the increased capacity of investors to utilise information technologies to bypass the middlemen in the marketplace, disintermediation is seen

positively, as a reduction in transaction costs. The online brokerages that 'replace people and telephones with computers and codes', for instance, are hailed as a 'consumer boon' (Barber & Odean, 2001). Similarly, the advent of so called e-finance is presented as furthering 'the longstanding evolution of the financial services sector from one dominated by financial intermediaries to one dominated by capital markets and financial institutions that hold marketable securities assets' (Allen et al., 2002, p. 10). Facilitated by electronic technologies, disintermediation has also been considered a means for raising capital in the stock market in a more efficient, less costly manner by directly accessing sophisticated individual and institutional investors (for a discussion, see Langevoort, 1998). In this sense, disintermediation has complemented the economic ideal of financial markets as efficient devices for the allocation of investments: through technology, they reduce transaction costs; and through novel regulatory and organisational arrangements, they render 'traditional' brokerage services arcane, granting individuals unmediated access to the marketplace.

As the history of the London Stock Exchange demonstrates, however, the myth of dematerialisation conceals the underlying physicality of markets and, as importantly, sociologically relevant forms of knowledge and practice that develop around the materialities that structure modern finance. In a similar way, the myth of disintermediation assumes a one-dimensional interpretation of the cognitive fabric of finance, one in which efficient markets are driven by the (objective) information possessed by buyers and sellers, making intermediaries costly and ultimately unnecessary participants of exchange. As the previous chapters, the purpose of the following pages is to deconstruct a myth by showing the tacit, contingent, local, conventional and subjective elements that found information in modern markets. Information, in a sense, is proven embedded.

In deconstructing the myth of disintermediation, this chapter performs three distinct tasks. First, it presents financial intermediation as an ongoing reconstitution of the social connectivities (on the definition and relevance of connectivity sin finance, see MacKenzie 2004) that bound and structure the securities industry.

Focusing on the member firms of the London Stock Exchange, this chapter shows that intermediation acquired numerous manifestations throughout the twentieth century, each responding to the broader social and economic state of the United Kingdom and the financial world-at-large. Hence, the following pages delve into the social history of the intermediaries who made the market for bonds and equities in the City of London, roughly between 1900 and 1990. And in doing so, this chapter acquires a second purpose, namely, to present an admittedly partial reconstruction of the dynamics that defined the practices and institutions of jobbers and brokers in the City of London's financial marketplace.

Second, by looking into the social history of intermediation in British finance, this chapter invariably touches upon the concept of gentlemanly capitalism, long used as an explanatory anchor for the social and economic history of the United Kingdom (Cain et al., 1986a; Cain et al., 1986b). In analysing the recollections of brokers and jobbers in London in the alleged years of transformation from a state of gentlemanliness to one of globalised Americanisation (c. 1960-1986), this chapter re-evaluates gentlemanly capitalism not as the descriptor of the organisation of Britain's financial and political elites but rather as a social imaginary that was re-invented during the constant re-negotiation between the remembered pasts, experienced presents and imagined futures of finance in the City of London. In this chapter, I adopt Charles Taylor's definition of social imaginaries – that is, I understand social imaginaries to mean the referents used by individuals to imagine their social existence, their obligations towards others, their expectations of behaviour, and the normative notions and images underlying these expectations (Taylor, 2004). Importantly, given that they are shared by large social groups, social imaginaries make possible a wide sense of legitimacy. The pervasive acceptance of democracy as a form of legitimate political action – even though precise definitions of the meaning of democracy vary considerably across social groups – would be an example of the type of elements that constitute our modern social imaginaries. Secularism provides a similar example – while its meaning is negotiated in the details, it is widely acknowledged as an integral part of the modern state. Indeed, within the socio-scientific literature, the concept of social imaginary is now utilised as a partial

substitute for ideology, in an attempt to explain broad historical changes associated to categories such as ‘democracy’ and ‘secularism’. Here, however, I approach social imaginaries at a ‘lower’ level, that is, as symbolic referents and normative expectations of behaviour that are shared by a relatively large community of practice, that link to broader imaginaries of social and political life, and that configure, in a way, senses of legitimacy. In doing so, this chapter stresses the fluid personhoods that framed financial practices and shows that they are irreducible to the conceptual shorthand of the gentlemanly capitalist.

Third, this chapter goes beyond the critique of gentlemanly capitalism as culture and identity of British finance. Specifically, it presents the evolution of financial personhoods in Britain in terms of the socio-cognitive identities adopted by brokers and jobbers. Intermediation, it is shown, always possessed a social and cognitive character, with brokers and jobbers having to understand the operation of the market in a located, material and embodied manner. The personhoods that developed around intermediation, however, adapted to the cognitive, regulatory and material tools available to those working on the floor and in the office. As the informatic discourse rose in prominence in the 1960s and 1970s, and as computers were incorporated into the practices of some member firms of the Stock Exchange, the personhoods of some British financial intermediaries reconfigured around the ideal of information. This reconfiguration, however, did not imply renouncing to the subjectivities and situatedness of the past. British intermediaries did not believe it was possible to delegate trust, decision and control to automated systems, considering finance an eminently subjective domain. Finance, for them, remained a human affair.

5.1 The network and its bonds

Prior to the advent of the automated trading systems that populate the contemporary landscape of British finance, the securities industry in the City of London was defined and structured by the interpersonal practices of single capacity. Without any doubt, single capacity – whereby the functions of broking and matching orders are institutionally separated – was the cornerstone of the market’s organisation and the

basis for the forms of intermediation that existed in the City of London. Writing in the late nineteenth century, George Gibson saw single capacity as 'one of the marked peculiarities of the Stock Exchange of London' (Gibson, 1889, p. 33). Until the so-called Big Bang in 1986, there existed at least two levels of intermediation within the market provided by the Stock Exchange. Those wishing to deal through its floor did so at a price, paying a commission to brokers and incurring in indirect costs through the spread between bids and asks (the 'turn') of jobbers. Firms seeking to raise funds in the capital market faced a similar double-layered access to the marketplace. Large underwritings required the interventions of merchant banks and brokers, and it occasionally proved necessary to conscript jobbers to advertise new issues on the floor.

The congealment of single capacity as both custom and rule of the Stock Exchange in 1909 made the division of labour on and off the floor particularly stable. In effect, the crystallisation of the separation between brokers and jobbers along with the inability of banks to become members, allowed for the emergence of specific roles and practices across the marketplace, for the growth of a community of individuals with distinctive characters, occupations and routines. Jobbers, for instance, became increasingly specialised. 'By making a speciality [sic] of a limited number of securities', wrote Charles Duguid in 1913,

> the jobber is able to keep his finger on the pulse of the market, and to gauge accurately at any moment its supply and demand. He must do this in his own interest, for he must ever be ready to buy and sell at the demand of the broker whom the public sends to him (Duguid, 1913, p. 35).

And due to their multiple undertakings and their constant interaction with companies and investors, brokers developed institutional formats of a particular kind. As Hamilton Whyte mentioned in his 1924 survey, a broker with a 'fair' connection 'may be able to earn quite a handsome income with the assistance of a clerk, a typist and an office boy, in addition to an accredited clerk attending the Exchange. (Whyte, 1924) (p. 39).

A large number of small firms characterised the organisation of the securities industry, with jobbers outnumbering brokers two-to-one at the turn of the century

(Duguid, 1913; Whyte, 1924). The firms comprising the membership of the Stock Exchange were of two broad types: the first, as individual entrepreneurs who had gained membership and were assisted by one or several clerks and typists; the second, as relatively small partnerships, some of which could afford supporting specialised departments within the firm. This organisation of the community of the Stock Exchange was the product of the relatively low restrictions on capital imposed on the membership. While it was estimated that membership to the New York Stock Exchange in the early 1920s cost about £14,000, and participating of the Paris Bourse could entail up to £90,000 in collateral, a candidate for membership in London

> only requires to obtain three members of not less than four years' standing who will each undertake to pay five hundred pounds to the creditors of the candidate should the latter be declared a defaulter within four years from the date of his admission (Whyte, 1924, p. 78-80).

The system that thus emerged was a market organised in terms of the size and wealth of the membership, which correlated to the ability to make markets in the case of jobbers and to the repertoire of offered services in the case of brokers. Jobbing, notes historian Bernard Attard, 'comprised a broad base of single and two-member firms and a narrow apex of market leaders who transacted the major business' (Attard, 2000, p. 14). And in broking, larger firms attracted the confidence of wealthier clients, with their size dictated 'not only by an increase of ordinary business but also through its undertaking special lines of work' (Whyte, 1924). The market of the Stock Exchange was hence heterogeneous. Variations in the size and composition of the firms created a certain complexity to the organisation of the marketplace, one that was recognised at the time. Large firms waned and disappeared. And small firms 'began their existence dependent on orders from friendly brokers (or even relatives) who may have encouraged them to start trading in the first place'(Attard, 2000, p. 16).

Despite its large and diverse membership and the relative ease of access to its floor, the marketplace of the Stock Exchange proved a stable structure, surviving both speculative bubbles and the economic hardships of the Great War. The resilience of the system originated neither from the dominance of technical expertise

over the market nor from aggressive marketing strategies on behalf of member firms. Broking and jobbing were far from being institutionalised professions. As Whyte (1924) noted,

> many persons are attracted into stockbroking whose claim to a partnership rests more on a large connection of wealthy clients than the possession of qualifications for such a post (p. 83).

'The average stockbroker', he wrote, 'has devoted little time to the study of economic problems at their source [with] Intuition rather than reason [determining their decisions]' (Whyte, 1924, p. 8-9).

Advertising, furthermore, provided no benefit when attempting to reach the pinnacle of the hierarchy or consolidate one's position in the marketplace. Members of the Stock Exchange

> [showed] much repugnance even to their names appearing in the newspapers in any connection whatever, though it may be quite apart from business, and some are even chary of announcing a mere change of partnership, or a removal of offices, lest it might be construed as an advertisement (Duguid, 1913, p. 42).

The stability of the market resided elsewhere: in its foundation upon the interpersonal connections that formed the social networks of the British economy of the early twentieth century.

To view the stability of London's markets as based on interpersonal connections is to recognise some of the key insights of recent scholarship in economic sociology. Advocating a departure from the canonical neoclassical model of anonymous, rational and instantaneous market exchange, economic sociology has revaluated the role of connectivities in the fabric of the marketplace. Within the growing literature in this field and its intersections with other disciplinary domains, a strong argument exists for understanding the economy as interactive exchange networks grounded on social relations between users, regulators and market participants. Indeed, social relations within the marketplace are of fundamental importance for the operation of economic life particularly because of the role they occupy as a scaffold supporting the stabilisation of market exchange. Social relations and the connectivities they imply, for instance, are central to the production of trust

in economic networks of exchange (Granovetter, 1985); and trust, in a sense, provides a mechanism for evaluating risks and dealing with uncertainty: in dealing with the settlement of deals struck on the floor one needs to trust that one's counterparties will deliver in due form and time; in dealing with a broker or intermediary, one needs to trust that he or she will obtain the best deal available in the market; and in dealing with an institution, one needs to trust that it is up-to-date with its regulatory commitments and that it will have the solvency and expertise to - operate in the future. The erosion of trust and the expectations it entails can have disastrous consequences, as Robert K. Merton observed: they can lead to market-failure, to the collapse of a bank, to a self-fulfilling prophecy fuelled by the evaporation of trust in an institution (Merton, 1948). But social networks and interpersonal relations are not only sources of stability. Through their persistence and reconstitution over time, these networks of social relationships also create an interface for signalling and learning amongst market participants (White, 2002). They generate small networks of transparency and predictability that allow aligning one's positions, redirecting one's actions according to what other participants say or do. They are, to an extent, a communication channel. Owing to their structuring character, social networks also establish specific modes and hierarchies of authority and legitimacy. Networks allow for the differentiation of economic activities not only in character but also in authority: some activities and groups within the market will acquire more repute, more trust, more importance; but acquisition of authority requires specific social and cultural investments that nurture trust and status within the communities of the network (Barnes, 1988; Podolny, 1993; Preda, 2005).

The variety of intermediated finance that developed within the walls of the Stock Exchange at the turn of the twentieth century is a paradigmatic expression of the relational and networked character of economic life. This is particularly visible in three constitutive spheres of finance. The first and perhaps most prominent of all was the market itself. Within the diffuse boundaries of this sphere, forging personal contacts with clients, bankers, financiers, brokers and jobbers provided direct and indirect economic and social benefits. As mentioned in preceding chapters, acquiring interpersonal knowledge of other market participants (ranging from their identities to

communal evaluations of the trustworthiness of firms and individuals) was quite necessary for navigating the at times busy and apparently intractable operations of the floor. However, this connectivity extended beyond the marketplace and into the broader set of social and economic relations that embedded the British securities industry.

New issues – through which capital was raised in the market by means of the introduction of new securities – illustrated particularly well the role occupied by relations in business. Whyte (1924) remarked,

> [The] real claim of a broker to a privileged position is that he will be able to place the underwriting of a sound issue which the public are not expected to take up. Such a claim can be established only by a firm with a wide range of wealthy clients. It is natural therefore that an underwriting broker in distributing his lots should favour those brokers whose businesses show that they have such a connection (p. 44-45)

The emergence of a distinct type of intermediary that worked on the margins of stockbroking – the so-called half-commission men – is also a revealing demonstration of the value of financial connectivity. Generally clerks 'whose personal equipment is limited but whose financial connection is extensive' (Whyte, 1924, p. 83), these employees received no salary but were granted half-commission on the business they took into the firm.

Wealth circulated across personal relationships. In effect, the maintenance of such connections implied specific forms of pro-social behaviour, some of which overflowed into attitudes towards newly adopted technologies. Upon their introduction, wrote Alan Jenkins, telephones were felt to be detrimental 'in dignity and good manners. Principals either wrote letters or went to see each other. Walter de Zoete, who retired from Zoete & Gorton in 1909, never used the telephone at all, although the firm had one since 1895 […] and thought his clerk Pericles Freme […] a "somewhat pushing young particle" for wanting to extend its use' (Jenkins, 1973, p. 122).

Yet relationships with clients were not only advantageous for brokers who took commissions on every trade. Such networks also functioned as mechanisms for

communicating market information to a wider audience. The British investor, enmeshed in an economy in the process of colonial expansion, and predominantly represented by private wealthy individuals who felt 'the dead weight of an ever increasing store of capital' pressing upon them (Investor's Chronicle, quoted in Platt, 1980, p. 8), often faced an opaque informatic landscape. In the market for overseas shares, the costs of telephones and telegraphs made acquiring data expensive. And in the domestic equities and new issues market, access to information was constrained by the absence of regulations on corporate reporting standards.

Ties with 'knowledgeable' intermediaries were hence profitable. As William Reader mentions in his history of the broking firm of Foster & Braithwaite,

> published accounts […] of companies of the highest repute did not need to reveal more than the barest minimum required to show shareholders, in the most general terms, how their capital was employed and how their profits were derived, and matters which the Directors found embarrassing or tactically sensitive could often, quite legally, be concealed (Reader, 1979, p. 146).

Bans on advertising amongst the membership of the Stock Exchange, which constituted part of a broader attitude of restraint towards the distribution of investment brochures and informative materials, transformed personal connections into two-way avenues of communication. As Michael Reed argued,

> by tradition, stockbrokers tended to be rather passive in their attitudes to clients, responding to orders given by a client, and requesting advice when specifically requested, but tending overall to let the client take the lead. [The network of personal contacts] provided a means for a more direct expression of the stockbroker's views (Reed, 1975, p. 160)

The networked relationships of trust, however, also enabled the deployment of self-policing schemes. By generating a certain level of transparency within the network, by controlling access to the membership, and by mediating the dissemination of information to the world-at-large, the connectivities of finance in London allowed establishing self-regulatory sanctioning mechanisms. The regulations of the London Stock Exchange, both on its membership as on the companies that wished to list shares therein, were predicated upon the possibility of maintaining order through a shared knowledge of the character of market participants that was not deemed accessible outside the walls of the organisation. Defaulters were seldom taken to

court. '[The] creditors in the Stock Exchange' wrote Whyte (1924, p. 103), 'never make [a defaulting firm] a bankrupt legally, preferring, of course, their own arrangements for dividing the estate'.

The hierarchical relations that supported the market were not limited to the floor and the business relations weaved between intermediaries, companies and investors. Structures of status and legitimacy spilled into a second sphere, the private organisation of member firms, and hence to the division of labour within the securities industry. As David Kynaston (2002) noted, firms, and in particular stockbrokers, 'depended hugely on the quality and character of [their] senior partner' (p. 165), their reputation in the market hinging on the individuals composing the higher echelons of the organisation.

Within firms, partners constituted the upper strata, operating at a level separate from clerks and general staff, and dictating the general policies of the organisation. Their recruitment occurred mostly through networks of family and acquaintances. In the firm, they specialised in connectiveness, cultivating personal contacts with others in finance, from peers and private investors, to bankers and wealthy financiers; that was their specialisation within the division of social labour of finance. Although each partner catered for a specific group of clients acting as a relational node of business, the responsibility for maintaining the bureaucratic structures fell on the shoulders of the office manager, a member of staff that served as the coordinator between the clerks and their superiors. Clerks, in particular, performed most of the routine operations of the firm, with some keeping 'in close touch with a client's affairs, [speaking] direct with them on the phone or [meeting] them when they came to the office' (Reed, 1975, p. 83). In effect, experienced clerks were a valued feature for firms:

> Harmonious cooperation between sections and a certain degree of all-round general knowledge is essential to efficient administration. This can be secured only by having experienced and competent men in each section. There is no business or industry where the adoption of the policy of what economists call 'the cheapness of high wages' pays better than in stockbroking. In a good business with a wide and influential connection, the working expenses as a rule are very low relatively to profits, and a wise partner in such a firm will pay liberally for reliable clerks. Inefficiency, causing frequent mistakes, may

> result in the loss of clients whose annual commissions exceed the cost of one or two first-rate office men. It never pays to risk a good connection by running the office cheaply (Whyte, 1924, p. 54).

The mobility of skilled personnel, and thus of the expertise nurtured over time, was hampered by the conventions of the City. For instance, it proved quite counterproductive for a member of staff to request a pay rise to his superiors: 'the prevailing culture of job immobility was such that [leaving a firm after a dispute over pay] was a black mark in the eyes of other potential employers' (Kynaston, 2002, p. 140). Yet however strict and rigid it may have been, the environment within the firms provided stability for both partners and staff. Junior and upcoming partners knew that with time, work and some degree of fortune they would eventually reap the benefits of seniority; and staff appreciated having a job assured for the future, insofar as the firm survived. Within the firms in the City of London there persisted an ordered systems of relationships (Reed, 1975, p. 85), dissociated from meritocratic structures, that generated 'an intimate, family-like working environment, knit together by seemingly inalienable ties of mutual trust and loyalty' (Kynaston, 2002, p. 141).

The connectivities of the market affected a third and final sphere, extending into the public life of the nation. In cementing the legitimacy of their institution and their trade (Preda, 2005), the membership of the Stock Exchange erected a thoroughly crafted public persona. The Stock Exchange was not merely a space for trading bonds and equities; it was not simply a serendipitous marketplace for wealthy investors. The Stock Exchange was construed, in a much more fundamental sense, as a national institution that serviced the kingdom and the world through shared codes of honour, trust and respectability. For Whyte (1924), there were 'few firms of outside brokers of the highest standing, possessing businesses superior in magnitude and status to those of the great majority of Stock Exchange firms' (p. 43). In effect, the very structure of the Stock Exchange's operations was praised as serving the welfare of the nation. Single capacity, along with the presence of an intermediating layer of brokerage services, was not rendered in terms of oligopolies and limited competition. Rather, these acted

> as something of a check in the interest of the public unversed in the methods of the market. Were an outside buyer or seller to deal direct with a market professional, he would be entirely at his mercy, whereas by employing another market professional to deal for him he brings into play the principle of diamond cut diamond. It is quite easy to bid on one's own behalf in an auction room, but it is usually found more profitable to pay a commission to someone who knows the ropes; and the intricacies of auction buying are not to be compared with those of transactions in stocks and shares (Duguid, 1913, p. 33).

Intermediation and the connectivities it implied were seen as a necessity, not a hindrance.

In the interest of maintaining an orderly and fair market, of allowing the 'right' decisions to be made, the public was enrolled into endorsing the community of the Stock Exchange. But, indeed, why should they not trust the membership, in its entirely male composition, to operate the engines of British capitalism? After all,

> members of the Exchange and the numerous clerks who spend their days in the market are a fraternity all by themselves. They are essentially of a sporting and good-natured temperament, patriotic in sentiment and generous in disposition [and whose] record of public service on public bodies rendered by members of this group compares favourably with any other class in the community (Whyte, 1924, p. 8).

Through the private spheres of the firms to the fraternal spaces of the floor, the image of the Stock Exchange accessible to the public through investment brochures and the press presented the institution as none other than the rightful core of the market. But this shared public understanding rested not only on the putative networks of 'old wealth' and the mirage of 'long traditions of caution and stability' (Hirst, 1932, p. 241). As fundamentally, it derived from the perceived constitution of its members and the trust onto them bestowed.

5.2 A spectre in the City

The connectivities of finance extended well beyond the walls of the Stock Exchange and the economic and social relations therein established and reproduced. Indeed, it has been long argued that the social networks of broking and jobbing were but small manifestations of a larger systemic order intersecting society, polity and economy in the British Empire. In recent years, the nature of these networks of capitalist

enterprise has been the subject of multi-disciplinary debate, not the least because they bear upon what is often perceived as a critical tension in the economic history of the United Kingdom, that between the 'visible' productive industries and the 'invisible' financial and services sector.

Scholars from history and sociology have sought to trace the intricate associations between the financial elites of Britain, the spheres of high government, the evolution of politics in the colonial dominions and the development of the industrial economy at large. They have procured, in a sense, the ingredients for a 'total' history, seeking to 'reconstitute the overall form of civilisation, the principle – material or spiritual – of society, the significance common to all phenomena, the law that accounts for their cohesion' (Foucault, 2002, p. 10). The law invoked, the principle created, was founded upon culture. There is, so argue a number of authors, a distinctive and readily identifiable cultural root to British capitalism, one that is inseparable from the history of industry, finance, the colonial endeavour and eventual decline.

The origins of this cultural argument are difficult to elucidate, perhaps owing to the conflation of the literature on the British economy with other narratives and intellectual strands. By the late nineteenth century, however, commentators were visibly keen to highlight an alleged social and cultural uniqueness in the City of London, not only in reference to the character of finance as a capitalist activity but equally important, when accounting for its embedding materialities. Writing in 1889 in his survey on international financial centres, George Gibson noted of the London Stock Exchange that

> [its] quarters are cramped, and it strikes an American that they ought to tear down the entire structure and erect one commensurate with the dignity and present requirements of the institution (p. 26).

The building, as mentioned in chapter 3, was an architectural hodgepodge, built in 1853 and expanded in following decades as the market grew in instrument variety and membership. Yet, amusingly, Gibson offered his initial explanation of the material state of the Stock Exchange by recurring to culture as opposed to the 'mere' rational-economic institutional constraints of the organisation. An impediment to

reconstruction, argued Gibson, was 'English preference for dinginess and the respectability of age, rather than spick-and-span architecture' (Gibson, 1889, p. 26), only then annotated with the difficulties posed by the separation between ownership and membership of the Stock Exchange.

An allegedly generalised and homogeneous culture in Britain, however, was deemed as extending beyond the seemingly pedestrian politics of building standards. Writing in the midst of the Great War, Thorstein Veblen was among the first influential social theorists to claim the existence of a social arrangement in Britain bonding a class-based culture, the political elite and control over the nation's capital resources. In *An Inquiry into the Nature of Peace*, Veblen wrote that the

> establishments of the democratic order, as they are now organised and administered, do somewhat uniformly and pervasively operate with an effectual view to the advantage of a class, so far as may plausibly be done. They are controlled by and administered in behalf of those elements of the population that, for the purpose in hand, make up a single loose-knit class,—the class that lives by income rather than by work. It may be called the class of the business interests, or of capital, or of gentlemen (Veblen, 1917, p. 93).

Britain, in particular, had been since the nineteenth century a 'government by gentlemen, for gentlemen, and of gentlemen', providing stability, however positive or negative, for the nation and its commercial and political endeavours. In effect, the uncertainties of the war in the Continent were potentially revolutionary, argued Veblen, as they might have led to 'a weakening of the hold of the gentlemanly classes on the control of affairs and weakening of the hold which the sacred rights of property, investment and privilege have long had over the imagination of the British people' (Veblen, 1917). 'The outcome', he alleged,

> might, not inconceivably, be the virtual erasure of the Imperial dynasty, together with the pedigreed-class rule on which it rests and the apparatus of irresponsible coercion through which it works, in the Fatherland and in its subsidiaries and dependencies (p. 153).

The dynasty continued, if not in Whitehall and the City of London, in the writings of social scientists for decades to come. Bankers, in particular, became a frequently dissected group through which scholars attempted to discern the mechanics of the purported culture-bound pedigreed-class rule in Britain. Although

by no means a flurry, the literature on the subject grew steadily over time and across disciplinary boundaries. In 1957, historian S.G. Checkland wrote of Britain's 'financial aristocracy—the investment bankers and issuing houses headed by Rothschild and Baring' (p. 262), as a group for which the 'assessment of politics and power were more important than economic diagnosis […]; to understanding the laws governing the general working of the economy [they] made no claim' (Checkland, 1957, p. 264, 278). In 1959, bankers and their systems of kinship became indigenous to sociology through the analytical gaze of Tom Lupton and Shirley Wilson: in their study of the Parker Tribunal[1], they revealed the '[shared] social origins and interconnections [of] the 'top decision makers' in British society' (Lupton & Wilson, 1959, p. 30). A shared (predominantly public school and Oxbridge-based) education, common club membership, and connections of kinship and affinity, argued Lupton and Wilson, accounted for the perceived informality and external intractability of the Bank of England's decision-making process. The articulation of this specific narrative with broader conceptualisations of the economy continued well into the 1970s. By 1973, D.C. Coleman had stretched the cultural argument into explanations on the relative decline of industrial production in Britain in the late nineteenth century. English business culture (the politically dominant form in Britain), argued Coleman, was grounded upon the only 'really important division' of the country's pre-industrial social structure: between those who were Gentlemen and those who were Players (p. 96). In effect, the decline of industry in Britain occurred, perhaps, 'because too many of the revolutionaries [were] too busy becoming gentlemen' (Coleman, 1973, p. 97). Bankers, and by proxy, the 'establishment' of the City of London, were construed as gentlemen.

The decisive conjuring of Britain's gentlemanly *volksgeist*, however, only occured in the turbulent 1980s when the literature consolidated around a common story. In 1984, sociology once again fed the narrative of an 'era of dynastic ownership and control' (Lisle-Williams, 1984b, p. 334). A 'gentlemanly' ethos, reverence for tradition, mutual trust, and observance of unwritten conventions were,

[1] The Parker Tribunal was set up in 1957 when two non-executive directors of the Bank of England were accused of profiting from prior knowledge of a change in the Bank's rate of interest (Hennessy, 1995)

among others, the cultural traits of an identifiable group that had sustained the forms of 'uncompetitive' family capitalism in banking that survived well into the twentieth century (Lisle-Williams, 1984b; Lisle-Williams, 1984a). In effect, the stability of the City of London and its microcosmic aristocracy was predicated upon more than a shared culture. It resided, so contended some authors, on the 'succession of marriages and intermarriages between a group of banking families and landed aristocracy' from which a renewed elite emerged, adding 'the financial power of the City to the prestige of the old aristocracy' (Cassis, 1985). The interests of the City were thus aligned to the interests of the political elites through blood and money, with familiar interests and their embedding culture of gentlemanly ideals exerted onto the industrial policies of the nation.

Historiographic reconstitution followed suit, with the publication of two articles that forged a new concept and congealed it into a species of orthodoxy. In 1986, Peter J. Cain and Anthony G. Hopkins introduced 'gentlemanly capitalism' as a key explanatory anchor for modern British history (Cain et al., 1986a; Cain et al., 1986b). Understanding the recent (and not so recent) past of Britain, they asserted, hinged on the recognition that the developments experienced between 1668 and 1914 were

> bound up with the evolution of several separate but interacting forms of capitalist enterprise—agricultural, commercial, and financial, as well as industrial. […] [Hence] discarding the assumption that non-industrial forms of capitalist wealth were either mere predecessors of the industrial revolution and were then subsumed by it, or were subservient by-products of one of its subsequent developmental stages (Cain et al., 1986a, p. 503).

Gentlemanly capitalism, they wrote, originated in 'the close of the seventeenth century [when] the landed magnates had ceased to be a feudal aristocracy and were ready to embrace a market philosophy' (Cain et al., 1986a, p. 504). With the landed rentiers followed traditions from a pre-modern order, with an assumed primacy of relations based on personal loyalties and family connections; 'contempt for the everyday world of wealth creation and of the profit motive as the chief goal of activity; and [..] stress laid on the link between heredity and leadership' (p. 504). The gentlemanly enterprise 'was strongly personal, and was sustained by a social network which, in turn, was held together by the leisure needed to cultivate it' (p. 509). The

system was, thus, ‘a formidable mix of the venerable and the new’, becoming ‘the touchstone by which all other economic activities were judged’ (p. 504-505). Ingrained in the culture of gentlemanly capitalism, they continued, the City ‘began and remained, an extended network of personal contacts based on mutual trust and concepts of honour which were closer to the culture of the country house circuit or the London club than they were to the more impersonal world inhabited by industrialists’(Cain et al., 1986a, p. 507). A spectre, so it seemed, lay behind the economic fate of industry in the nation, one that emanated from the cultural interstices of the networks of kinship of the City, aristocracy and the colonial administrators in their imperial dominions.

Although by design the expiration date of gentlemanly capitalism was placed at the end of to the two-and-a-half century period between the Glorious Revolution of 1688 and the end of the Second World War in 1945, its explanatory presence lingered in the air well into the years of the Cold War and beyond. After the Second World War, argued its adherents, the ‘gentlemanly capitalists who had once provided the framework for *Pax Britannica* now survived to fight another day under the protection of *Pax Americana*’ (Cain et al., 1986b). The spectre and the system of homogeneous relations that it established were summoned into being as late as the twenty-first century as a persistent element of the cultural landscape of British finance in the years of putative revolution in the City of London. But therein resides the appeal of total histories, in their ability to be stretched beyond the limits of a single time and space, becoming themselves the touchstones by which all stories are judged. Indeed, several commentators were eager to recur to gentlemanly capitalism as the cultural stick-figure on which to pin Britain’s economic malaise. William Hutton, an influential and widely cited political analyst, noted in his 1996 *The State We’re In* that gentlemanly capitalism

> culturally locks in much of the ‘spot-market’, short term behaviour that generates low investment […] we can contrast ‘spot-market’ capitalism, with its facility to allow buyers and sellers the ever-present chance to break their existing commitments and do better in a new market deal […] with ‘relationship capitalism’, where contractors are tokens of long-term relationships. […] Britain has over-emphasised the first at the expense of the second – and suffers thereby (Hutton, 1996, p. xix-xx).

And in his account of the seemingly disappointing transformation of the City of London in 1986, former stockbroker Philip Augar located the failure of British-owned broking firms in their inability to cope with the environment ushered in by Big Bang, in their 'lack of experience of institutional change' (Augar, 2000, p. 50). The City's institutions and values, wrote Augar, 'reflected three pillars of conservative England: the public school, the gentleman's club and the country house' (Augar, 2000, p. 33)(p. 33). This deep-seated cultural regime collided with an external system of global capitalism, spearheaded by internationalised investment banks with offices in London.

> Management was not used to deal with technology, change or the need to work at inter-personal relationships in larger firms. No one in the old City was prepared for a world in which the computer replaced the handshake. […] The new [British] entrants to the City had a more promising managerial skill set [but] were too handicapped by a value system which put time serving above merit and in which sound decisions could be marred by bureaucratic procedures (p. 39).

Gentlemen were unfit for the hectic world of deterritorialised, dematerialised and disintermediated finance.

The tropes of ancient honour, familiar networks, and unprofessional technophobia within banking and finance of late twentieth-century Britain were not constrained to commentary. Social scientists willingly embraced the gentlemanly story as the description of a tangible sociological British past. The spectre emerged once again, but now as an invisible bowler-wearing character sitting in the background of the interviews that formed an ambitious project drawing together oral histories of change and continuity in the City of London. Published under the title of *City Lives*, the accounts and recollections of some of the former inhabitants of the City's many quarters soon brought to the fore the historical dualities and boundaries invoked by Cain and Hopkins ten years earlier. The achievement of London, wrote the compilers in their introduction, had demanded

> A radical transformation of [its] financial techniques and culture: a transformation from the old slow-moving system based on the mutual trust of a gentlemanly British elite, to an incessantly demanding struggle with the ruthless instabilities of today's open global markets (Courtney & Thompson, 1996, p. xi).

Sightings of the elusive gentlemen continued. For human geographers, the knowledge-base of the City was structured by the gentlemanly discourse that soaked social relations and evaluative frameworks with notions of 'honour, integrity and courtesy, and manifested in ideas of how to act, ways of talk, suitable clothing and so on' (Thrift & Leyshon, 1994, p. 316). In investment banking, so it was argued, the discursive gentlemen were emblematic of London's financial landscape up until the mid 1980s, when American-style firms challenged the incumbents and came to set the agenda within the market (Hall, 2006; Hall, 2007). With these foreign competitors came 'a new generation of lawyers and bankers […] less tied to the quasi-aristocratic ideals and disdain for marketing that had characterised the 'gentlemanly' stock exchanges and legal practices of an earlier era' (McDowell, 1997, p. 3). Anthropologists embraced, too, the legend of a gentlemanly past. 'From the mid-1980s', wrote Caitlin Zaloom in her insightful study of an American firm's operations in Britain, 'London was no longer driven by English commerce and class ideals' (Zaloom, 2006, p. 76). The City of London's social changes were hence rendered as a succession of stereotypes, from the gentlemanly capitalists of a by-gone era, passing through the uprooted working-class 'Essex men' traders of the late 1980s and 1990s, to the university-trained professionals of today (Zaloom, 2006, p. 73-92). Sociology continued the tradition, with authors utilising the narrative of a gentlemanly past to draw distinctions between capitals of finance in the derivatives markets. The gentlemen, so it seemed, became social facts, existing in their own right, independent of their individual manifestations (Durkheim, 1966).

5.3 Castles in the air, people in the City

The allure of gentlemanly capitalism and the system of relations it implies is understandable: as the pillar of a total history, the concept provides a generous stream of ready-made signposts that enable drawing boundaries between the City of London and elsewhere in the world. For economic historians, it divides modes of production and capitalist enterprise, internalising apparent inefficiencies into their narratives of stasis and change; for human geographers, it provides the map of a place long-gone and the metrics by which its societal past were measured; for anthropologists, it stands as the placeholder for indigenous cultures of finance and

business in old London; and for sociology, it holds its meaning as the distinctive feature of the structures of social life in pre-globalised Britain.

The mobilisation of gentlemanly capitalism within the recent literature on finance in Britain falls within a wider tradition of critical rapport between the social sciences and economics. Indeed, gentlemanly capitalism is often utilised as a convenient vehicle for attaching social flesh onto the perceived skeletal narratives offered by the economic model of rational-expectations as the *vis viva* of market action. The proof of the pudding is provided by Linda McDowell in her skilful account of the co-construction of gender and work in the investment banking sector of post-Big Bang London (McDowell, 1997). In the introductory chapters of *Capital Culture*, McDowell turns to debates within economic sociology in order to account for the relations between so-called 'scripts', different types of exchange, and behaviour within specific institutions (McDowell, 1997, p. 22). In particular, support for the causal connection between 'scripts' and 'actions' is obtained from Zukin & DiMaggio (1990), who state that

> Culture sets limits to economic rationality; it proscribes or limits exchange in sacred objects and relations […] or between ritually classified groups […] [Culture] in form of beliefs and ideologies, taken for granted assumptions, or formal rule systems also prescribes strategies of self-interested action […] and defines the actors who may legitimately engage in them. Culture provides scripts for applying different strategies to different classes of exchange (quoted in McDowell, 1997, p. 21)

In her volume, McDowell used this and comparable arguments to successfully build a case for the role of a heteronormative masculine culture (somewhat indistinguishable from the 'common' variety of gentlemanly capitalism presented by William Hutton) in the performance of gendered subjectivities in investment banking. Similar findings are presented by Zaloom (2006), who showed the gendered referents mobilised in the trading rooms of Perkins Silver, an anonymised American firm with operations in City of London.

Critiques of the verisimilitude of gentlemanly capitalism are not limited to the commonplace observation that markets and society are, indeed, infinitely more complex than previously represented. A number of specific counterarguments exist

within historical scholarship, particularly within studies of the British financial sector of the nineteenth and early twentieth centuries. In his review of *British Imperialism*, the two-volume follow-up to Cain and Hopkins' 1986 articles, historian Geoffrey Ingham (1995) criticised the tomes' 'particular mode of argumentation which is suggestive rather than explanatory – intuitive rather than expository' (p. 345). There was, he continued, an 'inherent ambiguity of the project' produced, in part, by the multiple 'rather glib generalisations' (p. 346) populating the text. In addressing claims on the quasi-aristocratic history of merchant banking – a sphere that provided most of the sociological support for the thesis of gentlemanly capitalism – Stanley Chapman argued that the literature distorted the social diversity of the City of London. It did not mention, for instance, the role of foreigners and the business ideologies they professed within the British banking system (Chapman, 1986). The City of London, 'was more diverse and complex. It was the final goal for entrepreneurs gravitating to the centre of the international financial scene' (Chapman, 1988b). Claims of the survival of family and 'dynastic' control were also greatly exaggerated, argued Chapman, since the stories of failure were often swept under the rug. And in his analysis of the stereotypes presented in Courtney and Thompson's *City Lives* (Courtney et al., 1996), Ranald Michie concludes that the boundaries of finance in Britain were more permeable than the thesis of gentlemanly capitalism suggests (Michie, 1998).

The oddity of gentlemanly capitalism, however, resides in its persistence as an almost melancholic recollection of a bygone era amongst market practitioners from the City of London. References to the 'old' style of finance as based on a close-knit community, an exclusive members-only male club, are plentiful in both public and private spheres. Networks of kinship and friendships are often presented as the gates that gave previous generations access to the City of London's inner sanctum. Public schools and Oxbridge are commonly deemed the cribs of the financial and banking elites. And the apparent contempt for management and professionalised expertise is frequently encountered in accounts of the past. Within the stories of the Stock Exchange, allegedly one of the strongholds of gentlemanly capitalism, these signposts are no less common than in other areas of mythical dynastic activity. A

fraternal atmosphere reminiscent of 'jolly japes at boarding school, the officers' mess or the junior combination room of an Oxbridge college' (Augar, 2000, p. 35) is conjured in the memories of former brokers and jobbers. Donald Cobbett (1986), for instance, brought these images to the fore when writing of his experience in the 1930s on the reactions of the floor's inhabitants to the arrival of strangers, 'our name for the too curious interloper who occasionally […] gate-crash the privacy of the sacred floor' (p. 28-29):

> An intruder, particularly in those days of strict conformity to the commercial style of attire, would often cry out for attention variously by wearing the wrong clothes, perhaps smoking a pipe, or merely looking about him in bewilderment. The first Houseman to spot the stranger would immediately raise the cry 'Fourteen hundred!' […] [It] is said picturesquely to date from the latter part of the last century when for a long time the membership stuck at 1399, and consequently the presence of an outsider made up the round number. Nor was the stranger in those days allowed to slip away unacknowledged. A jostling crowd would at once form around him, impeding the efforts of the waiters, who by that time had arrived on the scene to escort the intruder off the premises. All this would take place to a polite but insistent chorus to 'Sit down!': a quite impossible endeavour, anyway (p. 29).

The technologists who built the infrastructures of the equities markets in London were also susceptible to the subject positions implied by the gentlemanly order. Some considered themselves as 'largely invisible, background people who did all the clever stuff but fundamentally were sort of plebs' (Buck interview). Others evoked the lunches of the Council of the Stock Exchange as relics from a strange past. 'We had the best wine cellar in London' recalled Peter Bennett, a director of technology at the Stock Exchange in the 1980s. 'We had a butler who'd dispense this wonderful, wonderful wine, silver cutlery, the whole thing was silver, it was wonderful, it was a great gentleman's club' (Bennett interview). And yet others recalled the division of labour in the organisation as erected upon 'a big social divide' that fell with the arrival of the Americans in the mid 1980s (Scannell interview). It is hence of no surprise to find publicists amidst the discursive mines of this mythical historical time, calling out the end of the golden 'City era of pinstriped, cigar-chomping old boy's network' (JP Morgan, 2006).

The root of this apparent inconsistency, of the survival of gentlemanly capitalism in the collective memory of both former and current dwellers of the City

of London, requires reinterpreting the term not as a descriptor of culture or the modes of societal organisation in Britain. Gentlemanly capitalism, rather, was but one of the competing and co-evolving social imaginaries mobilised within the communities of British finance. Forwarded by philosopher Charles Taylor (2004), the notion of a social imaginary proves useful: it places emphasis on the 'way ordinary people 'imagine' their social surroundings [through] images, stories, and legends [making possible] common practices and a widely shared sense of legitimacy' (p. 23). In effect, social imaginaries do not determine the manner in which actions are oriented or the way sense-making practices are structured. But they do serve as regimes of justification, as resources used for constructing legitimate boundaries, identities and historical rationalisations (cf. Boltanski & Thevenot, 1999).

But to say that gentlemanly capitalism is a social imaginary does not imply that it is insubstantial or inconsequential. Words and metaphors have weight upon our lives (Lakoff & Johnson, 2003). The shared images and stories that formed the ideals of a gentlemanly order were integral to the emergence of traditions and rituals of community that stabilised the connectivities of the market.

The London Stock Exchange, again, provides a wealth of illuminating examples. Amongst the most telling are those related to the manner in which the community of brokers and jobbers represented their institution and its practices amongst themselves and to the public. The *Stock Exchange Journal*, a quarterly magazine published by the Stock Exchange between 1955 and 1975, is a particularly convenient proxy of these representations and their underlying imaginaries. It is no coincidence, for instance, that the first issue opened with a foreword by C. F. Cobbold, Governor of the Bank of England, arguably the institution that held the highest position of status and repute within the City of London at the time (Kynaston, 2002). In addressing the readership, Cobbold welcomed the move of the Stock Exchange to make 'its doings better known to the general public' through the newly issued journal. 'Legends die hard', he wrote

> and there are still people who regard the City as a mysterious centre on high finance and money-dealing divorced from real life. But these legends are dying and the public are increasingly coming to realise how closely the City

> is interwoven with everyday commercial and industrial life and what a vital part it plays (Cobbold, 1955, p. 3)

Conveying a sense of 'real life' was certainly a component of the *Stock Exchange Journal*, albeit entangled with the images of gentility commonly associated to the leisurely life of the old City of London. A section of the journal was devoted to news of the associations of members and staff, ranging from the Art and Orchestral societies to the Cricket Club and the Football Association. Covering several pages towards the end of each issue, these small news items portrayed the Stock Exchange as a sporty and cultivated group of individuals, worthy of managing the affairs of a national institution. At the antipode of this section, one entitled House Notes offered summaries of pragmatic matters for the membership: from the availability of new services and notices on construction work in the building, to the death of former members and the election of new Councilmen. Between these two poles the *Stock Exchange Journal* engaged in business, with articles on the workings of overseas exchanges operating 'in vastly different conditions of temperament and custom from our own' (Anonymous, 1955a) to reports on the other House – the Houses of Parliament – in relation to governmental decisions that impinged on the economy.

Interspersed throughout its pages, the *Journal* also included historical articles (e.g. on the City of London's Roman origins or the days of the Coffee Houses on Exchange Alley) as well as recollections of the recent past, creating a sense of contrast with old styles of idealised (though patently anachronistic) finance. Poetic license was particularly useful in these cases. In a whimsical letter to the editors in which he described the changing reactions to intruders on the floor, R. H. Herford (Herford, 1956) wrote:

> The story is told that in days of old some Members
> were boist'rous and rough
> They guarded the door and the sacred Floor in
> manner decidedly tough.
> The Floor, then as now, was for Members alone and
> if anyone trespassed upon it,
> They'd hustle and bustle him, pull of his jacket, or
> batter him over the bonnet.
> BUT –
> Manners have changed with the passage of years,
> The trespasser now heed have no fears.

FOR –
We never now tear his clothes apart, nor hammer him
over the head.
But lightly, sprightly, very politely, usher him out
instead;
Conduct him to the Gallerie, in manner extremely
urbane:
And when at the view of the Floor he gets eager,
We take him to Pimms or perhaps to Bodega,
And after a Haig, a Domecq or a Seager,
We'll press him to come back again!
YES –
Manners and methods and customs and usages
change with the passing days –
We nowadays act with the greatest of tact,
for we've proved that politeness pays!!

The simultaneous construction of imaginaries of past and present was a constant throughout the life of the *Journal* – and arguably, of the community of the London Stock Exchange. Managing the borders between the old and the new, however, did not entail reviving the past in the present. Rather, it involved inventing traditions through which the community of the Stock Exchange established the membership of groups and the boundaries of the market, legitimated institutions and relations of authority, inculcated beliefs and conventions of behaviour (Hobsbawm, 2008; for an account of the invention of spatial traditions in the City, see Pryke, 1991). These traditions constituted both the rituals of community and the face of the organisation to outsiders. They were the routines of the family, of the brokers and jobbers, clerks and staff, 'who miss[ed] the same imaginary place' (Bissell, 2008).

One such invented tradition was the visitors' gallery, a public space created within the otherwise private realm of the Stock Exchange. Built during the chairmanship of Sir John Braithwaite in 1953, the visitors' gallery was deemed 'the most striking' innovation in the Stock Exchange's public relations policies since 1945 (Anonymous, 1958). Innovation in space, however, required subsequent innovations in labour. Initially, the gallery was unmanaged: for 6 pence, visitors would obtain a leaflet explaining the operation of the Stock Exchange and gain a glance of the trading floor. In due course, female guides were hired to tend to the

visitors in the gallery. As mentioned by the editor of the *Stock Exchange Journal* in 1958,

> the appointment of three young women to act as guides to the Exchange is quite a revolutionary move, and one which may well induce many older Members feelings similar to those which their fathers, in their own age, had when 'lady typewriters' were first employed in offices. From the Public Relations viewpoint the innovation seems a good one, and we look forward to hearing of its success. (Anonymous, 1958, p. 36).

The guides and their gallery soon became a fixture. By 1960, their photographs were included in the *Stock Exchange Journal* as a means for displaying their carefully selected uniforms. In the winter of 1960, 'the choice [was] for a clean-cut suit, its lines straight and simple, in warm cherry red frieze cloth and a half collar of black velvet' (Anonymous, 1960a). Generally positioned in the initial pages of the *Stock Exchange Journal*, the photographs were a reminder that, however pleasurable, the gallery was business above all. As the Chairman of the Public Relations Committee wrote in 1962,

> There can be no doubt how greatly these attractive and intelligent girls have helped in welcoming our guests and creating a favourable image of the Stock Exchange and its activities. Even though matrimony has proved a major occupational risk, we have not lacked for replacements, and it is one of the consolations attaching to the office of Chairman of the P.R. Committee that he is a member of a small panel which interviews and selects candidates to fill the vacancies. (Althaus, 1962, p. 3).

But, as the Stock Exchange moved away from its material past with the construction of a new building, the guides were traditionalised. The visitors' gallery likewise became a space for reconstructed history, for a certain archaeology of yesterday. During the 1962 Festival of the City of London, the floor was open to the public and the gallery became an impromptu space of spectacle and exhibition. Recalling the event, the *Stock Exchange Journal* noted the crowds showing

> great interest […]on the display of the Council's silver and the exhibition by the Exchange Telegraph of their Tape Machines past and present (Anonymous, 1962).

Crafting these imagined pasts was indeed a constitutive ritual of the new tradition of the gallery and its guides. Entering the 1970s, and with the contents of the *Journal* shifting towards the more mundane luxuries and fetishes of modernity (swimming pools were once featured in the *Journal*), the images of guides and their uniform joined the obituaries, anniversary, club and society announcements. They joined, in a

sense, the legends of an Edwardian era of sportsmanship, familiarity and honour. While finance on the Stock Exchange moved towards the global, the position of the guides and their practices of representing a grand old past were made tangibly local.

The legends of finance and their associated traditions constituted more than the public personhood of the London Stock Exchange; they mediated more than the visitors' gallery and the leisurely clubs of the membership and staff. Fundamentally, these legends were referents for the brokers, jobbers, clerks and staff who intermediated – directly or indirectly – the market. In bringing to mind a world of socio-economic gentility, of a grand old organisation, they colluded with practices on the floor and offices as much as with the relational networks of finance. They crafted, in a sense, specific market personas, a repertoire of stereotypes for the intermediaries of the City of London. Brokers and jobbers were not incidental middlemen in the long chains of financial transactions; but neither were they the natural inheritors of ancient financial blood. Intermediaries were, above all, providers of a service, embodying hubs of information for investors and companies, gatekeepers to the apparently opaque ebbs and flows of the market floor. Their personas were thus adaptive: as the landscape of British society changed, their behaviours and justifications followed suit, casting the legends of the past into new moulds for the future. And soon enough a distinctive mould emerged in the multitude with the rise of the computer as a central tool of the trade.

5.4 Genteel info-mediation

Seen as a cultural trait, gentlemanly capitalism is thus unable to explain the changing patterns of behaviour in British finance. Specifically, it fails to offer a convincing account of the progressive computerisation of British banking and finance from circa 1960s onwards (e.g. Batiz-Lazo & Wardley, 2007).

What, then, were the causes and effects of the adoption of information and communication technologies in the City? As several authors have argued elsewhere, information and communication technologies offered British financial intermediaries a tool for competition: in a system of fixed commissions, computer-based research

was an added-value service for current and prospective clients. Additionally, and as explored below, these novel technologies allowed reconstituting the role of the intermediary around the concept of market information. The intermediary, in a sense, was a craftsperson, mining, tailoring, fixing and offering information on the market. This, however, did not imply the end of social connectivities. On the contrary, information in the City of London was communicated through interpersonal means, through the social networks that structured British finance.

In the late 1940s, the connectivities of finance faced an environment quite different to the one prevailing at the turn of the century. The instabilities experienced between 1914 and 1945 resulted in a profound transformation of the British economy. In the realm of finance, restrictive exchange controls implied that the City of London was no longer lender to the world. Merchant banks effectively moved 'away from acceptances and foreign loans towards industrial finance and investment management' (Lisle-Williams, 1984a, p. 260). Death duties and heavy taxation levels on higher incomes translated into a decline of private investors; as Michael Reed noted, after the war 'there were fewer private individuals with the means to invest heavily through the Stock Exchange' (Reed, 1975, p. 90). Institutional investors – including unit trusts, insurance and pension funds – were now increasingly dominant in the market (McRae & Cairncross, 1973). The character of investments also shifted, 'with a greater proportion of [funds] being held in equities rather than debentures, preference shares, and Government securities' (Reed, 1975, p. 90).

This changed economic landscape had tangible effects on the organisation and operation of the securities industry in the City of London. The economic vicissitudes experienced in the aftermath of the Second World War made evident the strengths and weaknesses of both broking and jobbing firms. In the case of jobbers, the main issue was the undercapitalisation of firms vis-à-vis the requirements of institutional investors. As David Steen, a former jobber with Denny Brothers recalled, 'the institutions were dealing in larger sizes and wanted bigger markets, and there wasn't the capital there to handle it.'

> To take a simple situation, if you had a share with a reasonable turnover and the normal size of the market might be in 25,000 or 50,000 shares and some

> [institutions wanted] a price in a quarter of a million [shares], if you had plenty of capital you could happily take the risk […]. The point is that one risk tended to offset another, so if you got a lot of capital you can trade in very large size and your actual overall net risk in relation to your resources is no greater than it would be if you're a small firm where you'd normally made a price in 10,000, and hedge positions on that sort of basis. […] The thing about jobbing is really setting one risk as it were against another. […] If your jobbing firms have small capital then they'd be very unwise to trade beyond their means; but if the brokers want a bigger market then clearly the jobbers need more capital. And that was where the problem really arose (Steen interview).

Larger capital requirements provided an incentive for jobbers to incorporate (thus eliminating personal liability and reducing personal risk) and amalgamate (thus expanding the funds available to them). And so, from the heyday of the City of London in the early twentieth century to the turbulent 1980s, the number of jobbing firms reduced dramatically: by 1983, it is estimated that six jobbing firms alone accounted for 80% of the business conducted in the Stock Exchange (Augar, 2000; McRae et al., 1973).

For brokers, the difficulties were similar. Writing in his detailed introduction to the profession, Dundas Hamilton recalled that while stockbroking had once been 'largely a matter of having the right connections and using a certain amount of common sense […] today a far more scientific approach is made to investment' (Hamilton, 1968, p. 8). Given their direct dependency on commissions and the overall levels of market activity, brokers were particularly susceptible to fluctuations in the economy: as the markets contracted, brokers merged as a means of consolidating their client base and expertise and reducing the costs of clerical and research operations. The scars of economic crisis were visible amongst brokers: the number of firms almost halved from 294 in 1962 to 168 in 1973.

This reorganisation of the securities industry was rooted on wider perceptions of finance. For many, the Stock Exchange was as an anachronistic and conservative institution, 'politically out of favour and rather beleaguered and not looked on as a place of much excitement' (George Nissen, quoted in Courtney et al., 1996). Enveloped by such image, brokers and jobbers faced important obstacles when recruiting new talents who could adapt to the rapidly changing economic

environment. Particularly grave was the lack of expertise in areas germane to the requirements of institutional investors. Due to their relatively superior levels of sophistication, tending for institutional investors needed 'serious studies of the economic background, both at home and abroad' and for the 'evolution of new statistical measures of performance for the long-term appraisal of intrinsic value of investments in particular undertakings' (Menzler, 1958, p. 8). Unfortunately, people with such kind of expertise were diverted elsewhere early in their careers. Writing in 1958 in the *Stock Exchange Journal*, F.A.A. Menzler noted in a worrisome tone that those

> whose job it is to guide young people to occupations suited to their talents do not always place the Stock Exchange very high in the list of desirable employments. This is especially the case for those able young people who have to make their way solely by their own efforts. The absence of formal standards of education and training must lend colour to the idea of the old Stock Exchange as a select club rather than a profession, like other professions, success in which is dependent *inter alia* upon the attainment of high professional standards (Menzler, 1958).

Coping with the prevailing view of finance as a lacklustre activity, some member firms adopted strategies that echoed practices from the legendary 'dynastic' past. Brokers, for instance, relied heavily on their immediate social networks (Michie, 1998), recruiting 'rich young men and selling them partnerships. When brokers lived off personal clients, rich young men with wealthy contacts were also useful for the new business they could attract' (McRae et al., 1973, p. 116). Similarly, jobbers forged alliances with merchant banks in order to secure preferential rates on loans and to facilitate issuing new shares (McRae et al., 1973).

Indeed, the years following the Second World War were dominated by a conservative withdrawal, accompanied by a growing antipathy towards outsiders. They formed, in a sense, a period during which the imaginaries of gentlemanly capitalism were reinvented in response to a loss of public confidence in finance and the City of London. Those entering the City and its institutions at the time were instructed into the newly minted traditions, adopting as their own the redefined boundaries between insiders and outsiders. As historian Ranald Michie noted, perceptions of the financial past as a period of social invariance and dynastic control were encountered more frequently amongst those whose careers begun in the 1940s

and 1950s, that is, among those whose first experience in finance was framed by the reconstruction of the Stock Exchange as a 'noble' national institution (Michie, 1998). Such generational shifts were not minor, proving significant in years to come as illustrated by Alan Jenkins's observation on the admission of women to the Stock Exchange: it is perhaps not incidental that as late as 1971 the vote against including women members was led, so it was said, by younger members of the Stock Exchange (Jenkins, 1973, p. 186).

Despite the rituals and discursive formations that bolstered the imaginaries of gentlemanly capitalism, financial practices in the City of London were not immune to the demands of the day. But brokers and jobbers did not change merely as a passive reaction to wider macroeconomic changes. Beneath the conservative veneer of the City of London, behind the marble pillars and beyond the wooden floor of the Stock Exchange, brokers and jobbers were gearing up for a new economic landscape, with much of the redirection in practices revolving around the provision of services. However, in the new system, services were no longer conceived in terms of ad hoc interpersonal connectivities or networks of wealth. Rather, they were perceived as relying on increasingly professionalised expertise. They were seen as inseparable from the control and manipulation of market information.

5.5 Informatic revolutions

The re-intermediation of finance in London around new methods of management and professionalised technical expertise reached public visibility in the late 1950s and early 1960s. This derived, in part, from a newfound abundance of economic and industrial data. Having survived a decade of adjustments after the Second World War, brokers and jobbers were now awash with market figures, from company reports to ever-expanding tables of share prices, earnings and dividends. The origins of such torrents, however, traced back several decades and hinged as much on direct factors (i.e. the rise of institutional investment, developments in telecommunication technologies, and the consolidation of data providers such as Exchange Telegraph and Reuters) as on wider changes in the public conceptualisation of markets – from

the 1940s onwards, markets quickly grew to be considered indistinguishable from large-scale informatic processing and dissemination machines.

Evidence of a transformation in the public discourse on financial markets exists in the form of governmental debates on the role of the Stock Exchange during the war, where the influence of prominent economic theorists in the construction of this new paradigmatic interpretation of economic life is clear. As a particularly telling illustration, a memorandum presented by John Maynard Keynes in June 1940 to the Chancellor of the Exchequer's Consultative Council – an advisory body to the Treasury on matters of economic policy – forwarded an informatic perspective of markets as a matter of national security. From the perspective of Keynes, the Stock Exchange and its price formation system could be rendered as sources of signals that might potentially reveal vital strategic information to the enemy. Wrote Lord Keynes:

> [It] is difficult to see how the Stock Exchange market in equities could continue to function in the event of significant war damage. For details of War Damage are not to be published, so that those in the neighbourhood will be in the possession of information which shareholders and the market generally will not have. Indeed, it might be held that even the publication of Stock Exchange quotations might furnish useful information to the enemy. For if a particular aeroplane factory, or power station or a plant of Imperial Chemicals is heavily damaged, this will become apparent in the fall of the affected shares […] There may, therefore, be no way out except to suspend dealings in Home industrial Equities if and when the campaign from the air take on a really serious aspect (JMK/W/5/5).

Other voices within economics mirrored this metaphor of markets as communication channels; as mechanisms for generating, transmitting and processing signals; as informatic entities. Friedrich von Hayek is an appropriate exemplar of this perspective, owing to his conceptualisation of market indices as entities 'in which all relevant information is concentrated' (Hayek, 1948). For Hayek, the price system played a central role in coordinating actions within the marketplace, functioning as

> […] a kind of machinery for registering change, or a system of telecommunications which enables individual producers to watch merely the movement of a few pointers, as an engineer might watch the hands of a few dials, in order to adjust their activities to changes of which they may never know more than is reflected in the price movement (Hayek, 1948).

Indeed, references to information as a fundamental aspect of market (and, for some authors, broader societal) phenomena surfaced frequently in post-war economic literature (e.g. Grossman, 1981; Fama, 1970; Arrow, 1959). As the historian of economic thought Philip Mirowski argued, this constitutes an emblematic pattern of 'orthodox' contemporary economic literature, with authors steadily representing markets in cybernetic parlance, as entities based on information communication and computational processing (Mirowski, 2002).

Rendering markets as informatic machines, however, was not limited to academic realms. It would be naïve to think that such a fundamental change in meaning was constrained to the (highly porous) ivory towers of economics departments and the apparently inaccessible halls of government. In Britain, in particular, the rise of this perspective and the consolidation of market information as the putative blood of finance was the product of a confluence of changes in regulation, accounting traditions, public perceptions, broking and jobbing practices and the preferences of investors at large. With this transformation, the Stock Exchange and its floor became the central nodes of a national (and eventually, global) information network, operating as conduits for legitimate, veridical, instantaneous, and egalitarian data.

Such was the underlying lesson of Daniel Cobbett's comment in the *Stock Exchange Journal* of 1961. 'Utmost care should be exercised that company information is released simultaneously in all quarters' he wrote, 'and that there is no long time-lag between decisions in the boardroom and elsewhere and their general dissemination' (Cobbett, 1961, p. 11). Echoing von Hayek's metaphor of the price system as a signalling mechanism, Cobbett continued:

> In the case of a free market such as the Stock Exchange, reflective of a world-wide clientele with all its conflicting ideas and opinions, hopes and fears, discussion and rumour are necessarily inseparable from the other more factual influences which, at the end of each day's trading, the final price changes emerge. […] Since company information once inadvertently let slip ahead of time will inevitably be taken advantage of, still greater security should be enforced at its source—that is, actually in the boardroom. This means speed in transmission from the inner sanctum, and the elimination of successive hands in the process (Cobbett, 1961).

As information acquired a greater role in the public discourse on markets, and as demand for industrial data from sophisticated investors increased, the personhood of brokers and jobbers was recast in the language of information processing. Their public respectability – once supported by pillars of re-invented gentlemanly ideals – was given an informatic dimension.

The events leading to the information-centred practices and personhoods of the City of London of the late 1950s and early 1960s transcended the immediate area of influence of brokers and jobbers. Importantly, a transformed relationship between shareholders and the boards of companies nurtured the increased production, dissemination and use of market information: fuelled by debates on corporate disclosure and investor protection dating to the 1920s, the Companies Act 1947 (consolidated in the form of the Companies Act 1948) imposed for the first time in British regulatory history information requirements on limited companies. As explored by Josephine Maltby (2000), through the intervention and support of 'modernising' organisations that sought to develop better provisions for investors and shareholders – organisations such as the Committee for General Purposes of the London Stock Exchange, the Institute of Chartered Accountants in England and Wales, and *The Economist* – regulation introduced professionalised accountancy to everyday finance. The objectivising judgement, mechanised practices and complex trust-based politics of accounting had reached the securities industry (Porter, 1995).

The task of facilitating the dissemination of data to investors, brokers and jobbers quickly was internalised by the authorities of the Stock Exchange. Writing in the *Stock Exchange Journal* in 1957 on public relations in private industry, Gordon Cummings contrasted present standards with the austere annual reports required by previous versions of the Companies Act. 'Examination of the average annual report', he wrote, 'took no more than a few minutes, and by its omissions, often left more doubt than enlightenment in the minds of its readers' (Cummings, 1957, p. 48). Change, argued Cummings, came about through a number of 'outstanding factors'. The 1948 Companies Act, 'which laid down the minimum, and quite extensive,

information to be given in annual accounts' (Cummings, 1957), was but one such factor. Others included

> [the] steady widening spread in the ownership of public companies, backed by growing investment by insurance companies, pension funds and other institutional investors […] Replacement of 'family' direction by professional management as the appreciation that stockholders, as proprietors of the company, are entitled to be given the fullest information about the progress and activities of their business […] Press and other criticisms aimed at bringing about a better informed stockholder-ship [And finally, a campaign by the Stock Exchange] for more informative company reports and, of equal importance, the issue of interim statements (Cummings, 1957)

The imagined future embedded markets and reporting in a steady flow of information, of interim statements and quarterly reports. 'The day may not be too far away', concluded Cummings (1957), 'when boards of directors who do not issue interim reports will be in such a minority that they will stand out in their isolation—and risk the criticisms attendant on their lack of action' (p. 49).

The perspective of industry complemented the Stock Exchange's drive towards 'better informed' shareholders. The directive bodies of some companies were not only aware of the role of accurate and timely information but, indeed, actively promoted disclosure and shareholder engagement. Sir Leon Bagrit, then the head of Elliott Automation, illustrated this point in his 1962 contribution to the *Stock Exchange Journal*, where he recalled the responsibility of industry towards 'the Stock Exchange, and through it, the investing public'.

> Obviously the investor looks for a satisfactory and increasing return on his investment in the first place; but, in addition, to enable him to make the necessary judgements it is essential that, as far as possible, he should have adequate information […] Our attitude […] is based on the assumption that Stock Exchange firms, as well as banks and other financial institutions, owe the public a duty to study, on behalf of the large mass of investors, the information so made available [by companies] and to disseminate it to the investing public at large (Bagrit, 1962, p. 12).

With the rise of the cult of the equity in the late 1940s[2], investors and their broking agents 'required much greater research effort […] long-established personal connections were insufficient to guarantee business, and, more and more,

[2] Whereby investors switched from lower yielding government securities to industrial equities due to high levels of inflation.

stockbrokers had to go out to seek business, and to retain it by offering a high level of service in a competitive environment' (Reed, 1975, p. 91). The quality of information was thus of prime import: deficient data could hamper research efforts within broking and jobbing firms, potentially resulting in faulty advice to investors. The mutual responsibilities of companies and financial services providers were clear, particularly for industrialists such as Bagrit:

> the future value of the Stock Exchange as the mobiliser of funds for the nation's industrial development depends upon greater acceptance by companies of a responsibility to provide detailed information about themselves, and by financial institutions to make every effort to absorb the information offered to them and to use it fully—a task, the complexity of which in a world of fast moving technological change cannot be overrated (Bagrit, 1962).

5.6 Conduits and flows

The reconstituted personhoods that developed around market information were not merely a corollary of the apparently objective forms of accountancy that accompanied novel accounting practices and regulations on corporate disclosure. Similarly, they were not entirely determined by the growing availability of telecommunication technologies and the increasing scope of the services offered by data providers such as Reuters and Exchange Telegraph. The proliferation of computers systems, telecommunication networks, and standardised modes of information disclosure were not, in a sense, living proof of the triumph of mechanical objectivity – the thought that, as Theodor Porter (1995, p. 3-5) indicates, objectivity can be attained through personal restraint, by carefully abiding to rules and making sure that it is impossible for personal biases to affect the outcome of a process or, in this case, the quality of market information. Indeed, although 'the days of the third-hand 'tip', offered over a glass of sherry' were 'happily a long past' (Daniel Cobbett, quoted in Kynaston, 1991), structures reminiscent of the ad hoc networks and hierarchical connectivies that characterised an earlier incarnation of finance in the Stock Exchange continued to play a critical role in British finance. The character of these connectivities, however, was quite different. Now more than ever in the past, they were active instruments for creating information, probes that allowed intermediaries to gauge their wider industrial and economic surroundings and with it

to assemble data for distribution to investors. The City, in a sense, had become a factory of information as much as a centre for exchange.

At the time, information existed through a multiplicity of meanings and manifestations. The most prominent expression of mechanical objectivity was market information conceived as the product of impersonal and techn(olog)ically mediated labour. In discourse, this perspective was quite similar to the formalised propositions of information theory, one of the prominent engineering paradigms of the Second World War. For this theory, information was contained in symbolic messages, rendering its semantic (and therefore interpretational) aspects technically irrelevant. Messages and their meaning, after all, were standardised in language and routine usage, reducing analysis and system design to the optimisation of the communication channel (Shannon, 1948). Such definition of information as an entity 'contained' in messages percolated, in effect, the linguistic metaphors of numerous spheres (Lakoff et al., 2003). It was symptomatic, for instance, of the literature on economics and accountancy of the late 1960s and early 1970s, when firms, markets and financial statements came to be understood as the sources of stochastic signals amenable to an information-theoretic analysis. In the American accountancy tradition, a relevant example is found in the work of Lucy Lee and Norton Bedford (Lee & Bedford, 1969), who identified accounting as an unambiguous classificatory mechanism that produced a communication channel for the state of the 'financial life' of firms. In economics, the work of Henri Theil is particularly revealing, not the least because of his application of information theory to financial markets (as exemplified by Theil & Leenders, 1965). Views of a similar vein were expressed in the UK by several authors – most of which held some connection to the burgeoning area of operational research, another cybernetic offspring of the Second World War. In the British case, however, discussions were often framed in terms of a lack of sufficient information and the methodologies for its quantification. As the prominent British statistician Maurice Kendall mentioned in the 1960 Stamp Memorial Lecture

> There remains, [for economic analysis] one type of problem in the realm of data organisation on which a major assault is still necessary. It concerns the setting up of systems of measurement for quantities which cannot be recorded on a measuring rod or a dial […] Unfortunately a great many of the standard terms of economics are of this kind (Kendall, 1960, p. 9).

Indeed, if the financial machine was to work efficiently, if statistics were to contribute as oil for the gears of the economy, a precise informatic accounting of economic life was necessary.

Within the City of London, however, the dominant definition of information attenuated standardisation and mechanical objectivity with trust and interpersonal knowledge. This interpretation was particularly visible in investment analysis circles that, by the early 1960s, were advocating 'a greater release of information, together with standardisation of publication' (Mosley, 1962). The investment analyst, so it was said, judged securities not only on the basis of published accounts but also by 'absorbing a climate of opinion from the flow of articles in the financial press' (Morrell, 1962, p. 32). The negotiation of a definition that combined both standardisation and individual competencies is exemplified in a seminal article by D. Weaver and B.G. Fowler of the stockbroking firm Phillips & Drew on *The Assessment of Industrial Ordinary Shares.* Presenting a five-year dividend forecast model, Weaver and Fowler wrote that the

> greater part of the [investment analyst's] work consists of a close examination of the company's accounts and the chairman's speeches for a number of years, the usual practice amongst investment analysts being to study the accounts since 1948, i.e. since the Companies Act, 1948, enforced the publication of consolidated accounts (Weaver & Fowler, 1960, p. 247)

And although for them the ultimate objective of investment analysis was to 'establish a method for reviewing all the factors bearing on the appraisal of an individual share so that an objective value can be reached', Weaver and Fowler were careful not to

> stress unduly the objective nature of the methods – the investment in equities is and must remain essentially subjective – and it will have been noticed that the subjective element is much in evidence at many stages in the analysis.

The reactions to Weaver and Fowler's paper were equally telling. In the ensuing discussion at the Institute of Actuaries, G.H.R Goobey noted that

> the more he read papers such as the one under discussion, the more he was convinced that the measurement of the quality of management played a most important part in the assessment of industrial ordinary shares. The trouble was the difficulty of measuring the management. […] He was convinced that nothing could replace personal knowledge of the management and judgment of their capacities or, if that was not possible, enquiry could be made of people who were in a position to give judgment (Weaver et al., 1960, p. 281-282).

Information, regardless of its form, was invariably evaluated through interpersonal knowledge of the stock market and its participants. What existed in the City of London was a qualified form of mechanical objectivity.

It is in the above sense that the social connectivities of the City of London were reconstituted as active instruments for creating market information. For instance, at Cazenove & Co., a prestigious firm engaged primarily in corporate broking, detailed research into companies was built upon personal experience. As Patrick Mitford-Slade, a former partner at Cazenove's, recalled in interview,

> we knew the companies well. And we knew them from two angles. We knew them from the corporate finance side. One person would go to talk to the senior directors and the chairman about possible transactions they might wish to [make]. And another person from the research side would go in and talk to the treasurer or somebody on the factory floor and sort of get the feel of what the business was actually doing (Mitford-Slade interview).

The disclosure regulations of the Companies Act 1948 and its subsequent reforms were insufficient for the practices of brokers and jobbers as well as the changing preferences of investors. The mechanisms for evaluating companies continued to rely greatly on the identities of evaluators and hence on their ability to inspire trust, on their ability to create and maintain networks of sociality.

The interpersonal character of information was present even in firms equipped with sophisticated research and statistical departments. Such was the case of the Scottish stockbrokers Wood Mackenzie, which were among the handful of British pioneers in the provision of computerised analytical financial services (Eadie interview). Scott Dobbie, who joined the firm in 1970, recalled that

> a lot of the work we did would be trying to get attribution analysis by different segments of the company, the product and the geography. That wasn't published as automatically as now. We would spend months working through subsidiary accounts trying to build up a picture of where the business earned its money, create your internal model of the earnings so you could apply changes to changes in mix, and we did all that from the outside. But [we] would then go and see the company and have these discussions with them, bounce things off them. […] They wouldn't tell you the […] facts, but you would get much more help from them. The good analysts got much more help than the bad analysts. Now it's all got to be the same (Dobbie interview).

Cultivating relationships was therefore a definitional issue of the personhoods of brokers and analysts; their value was gauged not only in terms of technical abilities or immediate familiar connectivities, but also in relation to their capacity to establish informatic connections with people in industry and the market.

The continued role of social relationships was institutionalised in the bureaucratic organisation of firms. Dobbie recalled introducing 'focal points' (corresponding to an account director) to treat clients as 'proper' clients.

> Each client had a focal point in the firm, and he worried about the client, and he was responsible for the relationship. He got to know the client, and the same with the company. You'd got to know the company. I'd get to know their finance, certainly their finance director, if not the Chairman, of all the big companies we saw. I'd make sure I bloody well got to know them. We'd go around twice a year and see the finance director, then the ordinance director. […] We'd make a point of going and see the company there, we knew the chairman in first name terms, and so on. […] We actively worked on that. We'd have dinners with the chairman coming in to meet institutions. They hadn't done that before. These were all things we did. And that was all [1970s though] its commonplace now.

Similarly, in the institutional trading department of Phillips & Drew,

> Each man has an allocation of a small group of clients whom he claims to know personally. In the main it is telephone work, but frequent face-to-face contact is encouraged. [Brokers in this department serve their clients] by continually putting forward investment propositions in which we have confidence and which the client is likely to accept (Phillips & Drew, 1968)

The social arrangements of the City of London gravitated around networks of known individuals. Yet these networks were not dynastic structures built on wealth and blood; they were informatic webs which – efficient or not – allowed for communication and the creation of knowledge across different spheres.

5.7 Trust and silicon

The introduction of computers to the securities industry of the City of London was therefore less revolutionary than what the mythology of the information society suggests (notably, Castells, 2000a; Cortada, 2005b). Importantly, computers did not lead to a fundamental transformation in the intermediating relations of banking and finance but were rather absorbed into the existing system of interpersonal connectivities and local expertise. As Roger Nightingale, Director of Economics and

Strategy for Hoare Govett Ltd, wrote with the benefit of hindsight in 1985, 'computers and advanced forms of communication were employed enthusiastically […], but these new technologies left fundamental City relationships unchanged' (Nightingale, 1985, p. 60).

Data ordering and processing technologies in the form of tabulators and punched-card equipments entered stockbroking and jobbing firms as they did other areas of financial services: through the back office, as instruments designed to increase the efficiency and decrease the costs of clerical work. In the London Stock Exchange, for instance, such introduction occurred in the Settlement Room, where punched-card equipment was acquired during the late 1940s as an aid to the labour-intensive activity of matching bargains (for a discussion on this, see chapter 3). In 1948, the Institute of Actuaries, which was closely related to the life assurance community, discussed these technologies as helpful in recordkeeping and at simplifying 'the work of a life office valuation' (Coe, Hedley, & Longley-Cook, 1948, p. 260). Similarly, as early as 1945, building societies were using mechanical tabulators for individual account control (Batiz-Lazo et al., 2007).

Stockbrokers followed similar lines. When digital computers became commercially available in the early 1960s, their use in broking firms was initially restricted to 'investment administration and bookkeeping, or else comprised the production of lists of securities and current prices in sectors of the market where fairly simple analysis based on current prices would be useful' (Grant, 1983, p. 84). Computers, in a sense, inhabited primarily the General Office departments, from Contract and Settlement, to Registration and Dividends (Hamilton, 1968). Contemporary discussions on the uses of electronic computers clearly reflected this position. In 1955, for instance, readers of the *Stock Exchange Journal* were advised on the potential of computing for their firms. As a review of *The Scope for Electronic Computors in the Office* [sic] published by the Office Management Association mentioned, 'with £25,000 to spare, you can replace your clerks by an electronic engineer. 'Automation' is thought of as a thing of the future. From this book it would seem that to-morrow is already here' (Anonymous, 1955, p. 53).

Some firms, however, saw computers as an investment with relevance for other departments, including research and statistical offices that were becoming increasingly valuable for inter-firm competition. The developments at Phillips & Drew illustrate this co-evolution of value-added services and digital computing. As William Reader and David Kynaston noted in their history of the firm, Phillips & Drew was an early adopter of information technologies, having hired computer time as early as 1958 for calculating yields (Reader et al., 1998). Indeed, when International Business Machines launched their 1440 series in 1962, they caught the attention of Phillips & Drew. In an internal memo, senior partner Henry Cottrell presented the IBM system as 'specially designed for stockbrokers' (Reader et al., 1998, p. 136). The system, so argued Cottrell, could be used in established applications (preparing and printing, for instance, contract notes) but could easily be expanded to portfolio valuations, commission analysis and gilt price ratio statistics. As IBM explained in their formal pitch to Phillips & Drew, the 1440 system was not only the 'most efficient accounting system on the market [representing] cost savings which will increase with an expansion of [their] activities'. The system would also be a source of mechanised internal auditing, enabling the firm 'to obtain detailed analyses of the sources of [their] income, and their relative profitability' as well as to exploit their 'Data Processing experience [to] develop statistical programmes on [their] own machines' (Reader et al., 1998, p. 138). By 1966, Phillips & Drew's IBM 1440 was 'running 80 hours a week', and although it did not yet handle clients' accounts or dividends, it conducted 'an enormous range of work, some not even mentioned by IBM (sold transfers) and some much more complex than we then knew [computer ranking of shares]' (Reader et al., 1998, p. 140).

The aura conferred on computers as cost-effective substitutes for labour soon dissipated. Writing in 1968, Dundas Hamilton noted that 'none of the firms who have [moved from machine accounting to computers] has seen any savings in overheads, and many have been faced with higher costs' (Hamilton, 1968, p. 134). A memo from Henry Cottrell of Phillips & Drew supported these views: 'We shall never make a computer into a great success by savings in filing girls or contract clerks. The real

profit should come from the help it gives in getting business' (Reader et al., 1998). Although the promise was left unfulfilled, the adoption of computers had noticeable consequences in three aspects of the financial practices of the City of London.

First, computers enabled new modes of market analysis. In the mid 1960s, for instance, Denis Weaver and Michael Hall of Phillips & Drew developed a computer-based method for ranking shares whereby a multiple regression of past, present and forecast yield and earnings data was used to determine the cheapness or dearness of equities. Calculations were carried out initially on a hired Elliott 803 and later moved to the firm's IBM 1440 (Weaver & Hall, 1967). 'Like the alchemist', said L. Ginsburg in discussing Weaver and Hall's paper at the Institute of Actuaries in 1967,

> the authors had tried to transmute lead into gold. They took an inert mass of financial statistics and sought to convert some part of it into a profitable financial operation (Weaver et al., 1967, p. 214).

The ensuing discussion at the Institute of Actuaries showed that computer-based valuation techniques were far from uncontroversial. Professor Peter Moore from what would become the London Business School, for instance, questioned the independence of the selected variables and other discussants generally deemed that it was too early to judge the success of the method. Nevertheless, developments along these lines continued and were complemented by wider theoretical discussions on investment analysis. Thus, as price/earnings rations became an important analytical tool in Britain (Rutterford, 2004), they were incorporated to the computational models of Phillips & Drew (Hobbs, 1974; Hobbs interview). In effect, by 1970, Phillips & Drew was marketing a commercial advisory service based on their computational ranking model which ran in tandem with established forms of 'subjective' valuation (Reader et al., 1998).

Second, the adoption of computers facilitated the emergence of novel forms of market visualisation, as exemplified by the Scottish stockbrokers Wood Mackenzie. Along with Phillips & Drew, Wood Mackenize was among the first British firms to use computers for investment research. Indeed, much of the growth of Wood Mackenzie during the post-war period hinged on the firm's ability to conduct sophisticated research as a complement to their stockbroking services

(Cheine interview). As Dugald Eadie, the first computer manager at Wood Mackenize recalled,

> There were three main branches of our analysis in that first two-year period [1968-1970]. One was analysis of price movements, which is what we called relative strength and it was focused on something that nowadays would seem naïve, which was just producing charts to show the movement of the price of a stock relative to the index. And don't forget: the FTA All-Share Index which was used in the UK only started in 1966. So for us to produce charts of a price against the [index] and send them out to our clients was, actually, quite advanced. Then we had a service that was called the relative value and that was more about plotting things like P/E rations and yields of stocks and showing how they moved over time against the market. [This] was actually quite significant because in [those] days that wasn't information that was publicly available. And then the third service had to do with analysis of company accounts, what we called financial analysis, which would have to do much more with the fundamentals of the business of a stock you might invest in (Eadie interview).

Computers therefore served as nodes for collecting data and creating representations of the state of the market or the relative position of a firm. The representations were effectively aids for both analysts and investors. As Scott Dobbie, a former stockbroker with Wood Mackenzie, recalled,

> In addition to plotting the [price, yield and earning s relative to the FTA All-Share Index] for each security, one also superimposed the […] graphs on one page and hence identified anomalies between individual securities, or indeed industry sectors. This clearly assisted the search for value in portfolio construction. [We] were using computers in the early 1970s to carry out this work. It was initially done in the 60s by hand on about 300 companies. This involved meticulous calculation and graph construction (Dobbie, personal communication)

The service offered by Wood Mackenzie 'had the benefit that it covered the marketplace. It was a new product as far as the UK was concerned' (Cheine interview).

Third, the acquisition of computers for research implied establishing new relations with vendors (for instance, IBM), data service providers (including the London Stock Exchange, Exchange Telegraph and Reuters), users (such as fund managers and institutional investors) and workers within the firm (for example, securities analysts, computer programmers, economists and dealers). These relations,

in turn, came with specific sets of expertise, themselves gauged in terms of professional competencies. Scott Dobbie recalled that at Wood Mackenzie

> we were all professionally qualified people. And […] at the same time, the clients were becoming professional. And all the people we dealt with in the investment banks [that] were our contemporaries were all professional people and had come up through proper [routes, they] were all graduates. [Virtually] all of our analysts were graduates

Similarly, Dugald Eadie mentioned that, in pursuing research, Wood Mackenzie developed 'very large teams of programmers and systems analysts, and everything was done from first principles' (Eadie interview). One can speculate that the emergence of these arenas of interaction between experts was at the centre of the consolidation of educational institutions such as the London Business School and professional associations such as the Society of Investment Analysts. Although these were somewhat inspired by similar developments in the United States, where management was deemed to hold a unique prestige and mystique (Earle, 1968), they responded to the needs of a constantly evolving City of London (Barnes, 1989). The importance of these trading zones and the use of computers for research effectively required different approaches to recruitment. At the level of staff, expertise in programming, economics, statistics, operations research and finance were now at a premium, making professional qualifications desirable. And at the level of partners, individuals with managerial expertise, a basic knowledge of computers and on the organisation of international finance were increasingly attractive. Blood and familiar connections were not, in a sense, the structuring element of finance in the City.

Interpersonal connectivities, however, continued to play a fundamental role in finance. Computers were tied to some extent to the established system of personal relationships and the practices of the securities industry. The computerised share ranking system offered by Phillips & Drew's, for instance, was doomed from the beginning. As Martin Gibbs, a senior partner, wrote 'the analyst found it far easier to speak with conviction about their own recommendations than those of the computer ranking' (Reader et al., 1998, p. 150). The ranking was transformed into a weekly information sheet, showing actual and forecast yields and P/E ratios together with other data. The evaluation of cheapness or dearness, however, was left in the hands of analysts. In those days, recalled John Cheine, 'you couldn't bang on the door and

say ‘I’ve got a box of tricks I’d like to show you’. You had to be invited in’ (Cheine interview). Trust remained an affair between people. The personhoods of the inhabitants of the City, nevertheless, were not the same. Through their use in valuation and statistics, settlement and portfolio management, computers and telecommunications became part of the family’s mantelpiece.

5.8 The family dispersed

The incorporation of information technologies into broking and jobbing firms continued apace during the late 1970s. Writing in his 1979 review on the future of technology in British broking, Michael Josephs mentioned:

> A new trend has begun to show itself very recently. It used to be taken for granted that a computer system would be put in charge of its own special priesthood who would make sure that its perfect functioning was not contaminated by the presence of the ungodly. The real problem was to teach the priesthood about Stockbroking, and some organisations never succeeded. Now the control is moving back into the hands of people whose expertise lies in the Stockmarket and its workings […] The atmosphere has changed, and office staff who used to be afraid of the ‘electronic brains’ now take it for granted that they will operate keyboards and terminals as part of their work. The ‘punch girl’ who hammered holes into cards all day long without knowing what they meant is a vanishing species (Josephs, 1979).

Even the most conservative of stockbrokers, continued Josephs, had turned to computing services for automating back-office operations. Services such as those offered by NMW Computers Limited, a company created by the Northern and Midlands and Western Stock Exchanges in 1972, facilitated the diffusion of computing in finance by providing electronic accounting facilities to firms otherwise unwilling to invest in standalone systems (Johnson, 1974). For most of the firms, however, computers were no substitute for personal relationships. Computers were explicitly rendered instruments of intermediation.

The roots of the re-intermediated variety of finance that emerged in Britain in the 1980s were located within wider modifications of the institutional arrangements of the City of London. Just as the Companies Act 1948 facilitated the redefinition of financial practices around market-relevant information, the regulatory changes of the 1980s allowed reconstituting the personhoods of firms and individuals around the

imaginaries of a global variety of finance. Fundamentally, they allowed for the existing social connectivities to be redrawn. As Nic Stuchfield, a former jobber with Wedd Durlacher, recalled

> I don't think the technology has made the difference. There was a period when [the Stock Exchange] was a members club, and the floor was the clubhouse. That changes at the time of Big Bang. But, actually, there was still, and there still is, a lot of loyalty (Stuchfield interview).

The biggest drivers of change, borrowing from Stuchfield's recollections, were two modifications to the ownership structures of the financial intermediaries in the City of London: the first, a transformation of firms from partnerships to limited liability corporations; the second, the elimination of external ownership caps on member firms.

Although ostensibly superficial, these two developments reformulated social relations between market participants and broader structural arrangements within British finance. 'At the most simplistic level', argued David Hobbs of Phillips & Drew, 'you were no longer working for yourself as a partner. You were working for somebody else' (Hobbs interview). A similar view was expressed by Scott Dobbie in interview:

> all firms were [operating] as an unlimited liability partnership. [That] was one of the big constraints on firms that kept people out before Big Bang. [You] tended to join [the partnership] without paying any money. You got the good will for nothing. And when you left, you got nothing. You just left. But when you joined the partnership at first, you did a phenomenal amount of work and did not get a particularly good share of it. When you're at the end of your career, you get a phenomenal share and don't do much work. So the guy pays through his goodwill and a lot of hard work when he's young, and the older partner collects and doesn't do so much work. Now that's all changing, but that's how it worked before.

Under limited liability, the incentives for professionals within firms were different. Betting on long-term horizons was now economically inefficient, giving way to what Philip Augar (2000) termed the 'cult of the individual'. Trained in an environment different from that of their predecessors, the newcomers recruited into the City's ranks constituted, according to Barry Riley, former editor of the *Financial Times*, an

> influx of quite different meritocratic sort of people [into] firms [changed] the character of the Stock Exchange itself and, I suppose, contributed to the Big Bang process and the way it was accepted because those sort of people could

> obviously see that there was a lot potential there which was being suppressed while the Stock Exchange remained a club (Riley interview).

The imaginaries changed. The legends of British finance were no longer staged on the floorboards of the old Stock Exchange building. They were now set in the trading floors of a City of London reclaiming the legends of its global past.

Change, however, came at a price. As brokers and jobbers were absorbed by investment banks eager to have direct, unmediated, access to the market, failed corporate marriages followed, populating the pages of the *Financial Times* in the aftermath of Big Bang. The causes of the widely dissected demise of British firms are difficult to identify. Yet one could find in the imaginaries of global finance a possible seed of conflict. As John Cheine recalled with hindsight, 'we came to the apparently rather conceded conclusion that there was more to our game than we had imagined' (Cheine interview). The vicissitudes of British finance, the death of the gentlemanly capitalist, and the reform of the City of London were thus, in part, the result of holding too narrow interpretations of the intricacies of finance. As Cheine recalled,

> I was reading something in the papers the other day. I do not believe in the argument that says, 'Mr. Smith is a brilliant manager, and doesn't matter whether he's running the Post Office or a consumer products company in Latin America, he'll make a success of it.' To which my answer is balls. Now, there have been people who superficially have moved from one industry to another and been successful. And there are people who clearly have that sort of transferable skills in an infinite way. But as a generality, I think it's a load of balls. And I think it's that sort of feel that we're talking about that says 'just because you're good at this doesn't mean to say you're good at that'.

The history of finance, after all, is not written upon flows of information, through standardising practices and under the ubiquitous glow of trading screens. Finance is built upon social connectivities and the legends of sweat and blood, of electrons and artifice, that bring them into being.

5.9 Embedded information

What, then, is the sociological lesson of this chapter? Contemporary descriptions of the development of the securities industry stress, quite unduly, systemic change as a

revolutionary process. Change, it is theorised, is often constrained to moments of overhaul, catalysed by the introduction of novel tools, organisational structures or practical techniques. In Britain, the latest transformative moment was arguably Big Bang in 1986. Represented by the introduction of double capacity, the opening up of the Stock Exchange's membership, and the end of dealings on the trading floor, Big Bang is commonly deemed a watershed in a profound historical discontinuity, or to use Philip Aguar's (2000) more colourful allegory, an incident marking the death of gentlemanly capitalism.

In narratives of discontinuity, computers and telecommunications are often invoked as sources of change, not the least because accounts of the broad transformations of the twentieth century are frequently expressed in terms of the rise of an information, networked or postmodern age. Big Bang, for instance, is presented as a two-fold transformation: not only were there changes in the organisation of the Stock Exchange (i.e. its social structures) but, as importantly, there was an experiential modification of the market when dealing migrated from the trading floor onto the electronic platform of SEAQ (see chapter 4 for a detailed discussion of this process; see also Hamilton, 1986). Big Bang not only symbolises a reconfiguration of social institutions in British finance; as importantly, it signalled the début of the information age in the City of London and, with it, the decline of social structures and their replacement by structures of flows (cf. Lash, 2002). Big Bang was a 'turning point', representing a new 'financial freedom [that] allowed capital from all sources to be mobilised from anywhere to be invested anywhere' (Castells, 2000c, p. 104). The actors, the networks, the non-humans, the interface of humans and machines and, importantly, information were disembedded. Post-modernisation of finance meant the replacement of social structures by information and communication structures (Lash, 2002, p. 9, 28).

The introduction of information technologies to the financial practices of the City of London, however, was a gradual and differentiated process. Not all firms ventured to 'feed their business into the machine', preferring instead to direct their investments to nurturing social connectivities – which, as mechanisms of social

brokerage, were in themselves profitable. Others, such as Wood MacKenzie and Philips & Drew, found in computers a tool for competition, an instrument for providing added-value services to their clients. Importantly, however, the information used in the conduct of finance was tempered by the interpersonal knowledge of market participants, independently of the systems adopted or the mechanisms set in place in the office. Observing with hindsight the changes of the decade since Big Bang, Sir Nicholas Goodison saw still the connectivities of yore, albeit inscribed in the new organisational arrangement of the City of London. The social camaraderie of the past

> has gone very much into the firms. As I said earlier some of them are now very big, and not difficult to keep that spirit of camaraderie on some of the firms' own trading floors. I call them trading floors, they are actually trading rooms, and you have I am sure seen them, they are now banks and banks of desks with screens on them. But they have much of that feel of the old trading floor, while not having the creaking floorboards and the stamp of the feet and the huge crowd. But I think a lot of that has gone into the trading rooms of the big firms. But don't forget that people acting for clients get to know them pretty well too as a result of daily telephone contact, and would be meeting them outside for social purposes or indeed playing cricket against, when the two firms play cricket and so on. So it's not all lost at all. The human being is a naturally social being, and it would take more than the abolition of the old Stock Exchange trading floor to undermine these social aspirations (BL/NLSC/C408/09, 1995).

The social history of British finance was as much a story institutional and technological transformation as of the redefinition of market information and the social connectivities through which investment advice was generated and deployed. But despite the numerous occasions in which its meaning was re-negotiated, information in the market remained a social, embedded, and ultimately intermediated affair.

deregulation

6 *Dictum Meum Pactum*: Making the Market a Regulatory Object

On 23 June 2009, the Treasury Committee of the House of Commons met to hear evidence on the state of banking and supervisory regulation in the United Kingdom. The parliamentary inquiry that gave rationale to the meeting manifested the sense of crisis that had imbued Westminster, Whitehall and the City of London for over two years. Although some asserted signs of recovery – the FTSE 100 stood above 4,200 points, 700 more than the five-year low of 3,512 points reached two years earlier – a sense of uncertainty remained in the air.

Crisis was not restricted to financial institutions. Importantly, the disarray extended to the formal regulatory systems that, since the 1980s, had been built around the banking, securities and insurance markets. In effect, on the day of the Treasury Committee's first hearing, one of the topics for debate was the performance the Financial Services Authority, the statutory regulator of the banking and securities industry in Britain. For John McFall, Chair of the Committee, among the questions for the day was the culpability of the FSA in the development of, and response to, the financial crisis. Had the FSA, asked McFall, just closed the stable door after the horse had bolted out?

The Committee's concern partly derived from the *Turner Review*, a policy document published by the FSA in March 2009 in response to the global financial crisis that initiated in the American mortgage market in 2007. For the authors of the *Turner Review*, the characteristics of the crisis challenged prevailing theories of financial economics, raising doubt on the validity of the 'intellectual assumptions on which previous regulatory approaches have largely been built' (Financial Services Authority, 2009, p. 56). In the opinion of the FSA, future regulation required a systemic strategy, focused on the traditionally unexamined risks and interconnectivities of the financial system. The canonical approach of financial economics, however, proved insufficient. Thus, in referencing theory, the authors of

the *Review* substituted the names of yore – Fischer Black, Eugene Fama, Merton Miller, Robert Merton and William Sharpe – by a peculiar cohort mixing new and old – from John Maynard Keynes and Benoit Mandelbrot to Hyman Minsky and Robert Shiller. For the FSA, rational investors were making way to irrational crowds in the regulatory paradigms of the future.

The change in the theoretical approach of the FSA reached the corridors of Westminster through the Treasury Committee's inquiry. For Andrew Lilico, a consultant from Europe Economics and witness before the Committee, the *Turner Review* was 'a mistake',

> We have a set of financial regulations which grew out of certain assumptions which were then interpreted through economic theory so as to produce some recommendations, so [the FSA] decided that those recommendations did not produce the results [they] liked, and what the Turner Review then did was to ditch the economics (Lilico in House of Commons, 2009, p. Ev 1).

In their attempt to plan for the future, argued Lilico, the FSA had thrown the baby out with the bathwater.

Lord Turner of Ecchinswell, Chairman of the Financial Services Authority, disagreed and defended the regulatory stance of his *Review*. Future stability, argued Lord Turner, could not be guaranteed by greater transparency, improved disclosure and more effective market discipline. For him, the evidence against the incumbent approach was clear:

> even though there was not perfect information in terms of individual bank accounts back in spring 2007, I think it was a reasonable thing to believe that the level of risk within the financial system was increasing—given the scale of the increase of a credit extension, given what we already knew about sub-prime mortgages in the US, et cetera; and yet aggregate, on average, bank CDS spreads, rather than going up, continued to fall, to reach pretty much an all-time low in about June 2007. Therefore, the thing which is meant to give us a forward indicator of risk failed almost entirely. I do think that we have a problem of the fundamental nature of financial markets. The concept of market discipline in response to transparent information depends crucially on the idea that market prices will reflect all of the available information rather than reflect herd and momentum effects. I think that to a significant extent they reflect herd and momentum effects. They serve as available information.

For Lord Turner, the water needed changing.

The debate between Lord Turner and John McFall, between the FSA and Westminster, has a common denominator, a specific – and today, widely accepted – conceptualisation of financial life. Behind their disagreement, Lord Turner and John McFall share the notion that markets are systems amenable to the bureaucratic, technical and rationalising control of the state. In effect, for their conversation to have sense, they both presuppose that the market and its errors can be fixed through specific forms of representation and intervention.

But how is it that we came to conceptualise the market as an entity that can be fixed through technical intervention? How is it that we rendered the market *manageable*? This chapter addresses these questions by analysing the rise of financial regulation in Britain throughout the twentieth century. In particular, this chapter presents a socio-historical examination of the formation, stabilisation and transformation (pace Fligstein, 1996) of three broad regulatory epochs: an initial epoch, in which regulation occurred primarily through the symbolic and social actions of self-policing status groups; a second epoch, characterised by government-sanctioned modes of bureaucratic self-regulation exemplified by the creation of the Panel on Takeovers and Mergers; and the third epoch, defined by the proliferation of statutory instruments and the formation of an external supervisory agency, the Securities and Investments Board, predecessor of the FSA. Regulatory sense-making in each of these epochs, I argue, was coordinated by a specific model of finance, which allowed for individuals to direct their actions, establish conventionalities of meaning, and determine legitimate forms of behaviour and sanctioning.

The argument here presented claims that the transition between epochs responded to a combination of three processes. First, it derived from a substantial change in the boundaries of legitimate regulatory action within the market, related to a re-constitution of the divisions within the City, and between the City and the state. Historically, changes in the boundaries resulted either from opportunities offered by crises of confidence within and outwith the financial sector (e.g. the crisis of legitimacy associated to the corporate scandals that led to the creation of the Takeover Panel), or moments of overall re-configuration (e.g. so-called Big Bang in

1986). Second, these transitions were associated to the emergence and consolidation of particular forms of expertise on the market within the juridical field (Bourdieu, 1987). For instance, changes in the cultural circuits of capital that led to the consolidation of financial economics as a source of legitimate knowledge on the securities industry allowed for the deployment of a discourse of regulation based on the metaphor of the market as an information processor. This, in turn, affected the instruments of regulation, defining the scope of observation and action of the regulatory agencies. Third, changes between epochs were related to the reconfiguration of the material supports of the market. As technological arrangements became central to the operation of the securities industry, they became ever more important as objects and instruments of regulation. In sum, authority, knowledge and technology colluded to create each regulatory epoch.

6.1 Rules, regularities and order

What do we understand by regulation? Within the specialised literature, regulation is often presented as a distinct form of legal-political action and authoritative intervention. In particular, the term regulation is invoked in reference to the extension of the state's influence in social and economic affairs. Thus, for the *Encyclopaedia of Law and Economics*, regulation constitutes the 'employment of legal instruments for the implementation of social-economic policy objectives' (den Hertog, 2000, p. 223), with legal instruments understood as state-sanctioned mechanisms that compel individuals and organisations to behave in prescribed ways. In Stephen Croley's analysis of regulatory theories and their relation to administrative bodies, regulation is concomitant to the rules and guidelines promulgated by government agencies 'prescribing, proscribing and conditioning the behaviour of individuals, groups or firms' (Croley, 1988, p. 3). And in Anthony Ogus' *Regulation: Legal Form and Economic Theory*, regulation comprises the law that implements a system where the state 'seeks to direct or encourage behaviour which (it is assumed) would not occur without such intervention' (Ogus, 2004, p. 1-2). Regulation, then, is conceptualised as a legal-administrative object used to intrude in socio-economic spheres that are, in principle, independent from the state.

As such, the most prevalent understanding of regulation is constructed around theoretical traditions and legal doctrines that describe the role of the state in organised capitalist societies. In a sense, regulation is only made observable and intelligible through such theories and doctrines by distinguishing it from other forms of authoritative intervention, be they constitutional, criminal or tort law, intra-organisational rules and guidelines, or unenforceable ethical codes of behaviour observed by specific communities of practitioners. Regulation is thus apprehended in different manners, following the assumptions of the theory used to describe the regulatory process. For instance, with its foundations in neoclassical microeconomics, public choice theory represents regulatory decision-making as a market process (Croley, 1988). Legislation, regulation and other forms of state control, so goes the theory, are the outcome of the exchange of so-called 'regulatory goods' between political interest groups (e.g. citizens, firms, advocacy groups), following laws of supply and demand. Policies are formed at the points where equilibrium is reached between the providers of the goods and those that demand them. Regulations, furthermore, are understood in an overtly economic sense either as taxes imposed on particular activities or groups, entry controls in specific industries, restrictions on the ability to substitute or complement goods, or mechanisms of price-fixing in the marketplace (Stigler, 1971). In contrast, the literature on the sociology of risk adopts a broader view. By engaging with the increased rhetoric and technical role of risk in modern organisations, this literature presents regulation as part of larger systems of governance and management that are involved in delineating, legalising and making accountable 'uncertainties' (Power, 2007). Regulation, from this perspective, comes in a richer variety than in public choice theories, taking the shape of general principles, rule-like governmental legislations, audit and internal control protocols, and in general, devices of organisational accountability and uncertainty calculability that take numerous forms.

The literature on financial regulation is no exception, being largely subordinated to broader theories of state control of industry and the promotion of competition. Given its character, it is also not surprising that analyses of financial regulation are strongly influenced by economic approaches – for instance, presenting

optimal regulatory systems as those in which the regulated can opt into competing frameworks in order to foster innovation (Macey & O'Hara, 1999). Financial regulation, furthermore, is often assumed to take the form of explicit rules, guidelines and surveillance mechanisms instituted by centralised governmental agencies that oversee the operation of the market (a paradigmatic example being the Securities and Exchange Commission of the United States). In doing so, the literature obscures the wider web of instruments, institutions and modes of intervention that organise the market: regulation, arguably, is also composed of elements of civil, contracts and corporate law; global standards and directives on accounting, clearing, settlement and data communication; internal guidelines of behaviour; professional boundaries; and tacit – yet socially sanctioned – forms of interaction.

There remains, hence, much to say about the sociology of financial regulation. Specifically, a sociologically-informed approach must be able to re-evaluate the somewhat mechanical models of agency used within the literature on law and economics, where regulation is essentially any form of 'behavioural control [of the state] over the valued activities of a particular community' (Ogus, 2004, p. 1). A sociology of financial regulation requires additional flesh on the skeleton of the canonical representation of economic actors as 'rational' agents.

A starting-point for this re-evaluation is provided by Michael Moran's analysis of the regulatory framework of finance in the 1980s. In assessing the predominant definitions, Moran forwarded what he called a 'narrower conception, picturing regulation as an activity in which the discretion of individuals is restricted by the imposition of rules' (Moran, 1986, p. 185). For Moran, the so-called rule-based conception makes the study of regulation manageable 'by separating the activity from the exercise of other forms of power'

> Above all, by focusing attention on rules it forces us to consider the central analytical problem of regulation: how to cast rules; how to constrain regulators and regulated within those rules; and how to reconcile the fact of change, and the necessity for adaptation, with the creation and maintenance of rule-governed institutions (Moran, 1986, p. 186).

Moran's approach is anchored on the etymological roots of regulation. In every-day language, regulation is perceived as the instrument used in the act of regulating. To regulate, in turn, is to govern, direct or control by rule. Thus, regulations are synonymous to rules, and regulatory frameworks are rendered collections of rules, sets of explicit linguistic/administrative entities that have observable consequences on the behaviour of social units be it by wilful acceptance or authoritative coercion.

To invoke rules as the constitutive matter of regulation is, however, a path that I will not follow. Rules have the problem of obscuring the sociological mechanisms through which order is formed and maintained within specific settings. Rules are too often presented as black-boxes of agency, giving normative systems a veneer of external objectivity and minimising the internal and contested political work that is carried out to maintain stable social and economic relations. Effectively, a sociology of financial regulation can benefit from a critical examination of rule-following. In this sense, it can find theoretical inspiration in the sociology of knowledge and its correlate, the performative theory of social institutions as built by Barry Barnes, David Bloor and Martin Kusch (Barnes, 1983; Barnes, 1995; Bloor, 1997; Kusch, 2002).

For the performative theory of social institutions, issues of social order and collective coordination are wholly approachable by conceptualising knowledge, practice and meaning as systems of collective, conventional, self-referential, and normative processes. Here, the work of Barry Barnes is conspicuous for its ability to deal with the sociological characteristics of rules in institutional environments, providing a platform for the theoretical analysis of regulation. In his examination of Max Weber's theories of bureaucratic organisation, Barnes observes that the rules through which control is purportedly maintained 'lack power and cannot explain the practice with which they are associated' (Barnes, 1995, p. 203). Bureaucracies, rather, are 'genuine social formations involving the social relationships necessary to sustain shared understanding and practices' (Barnes, 1995, p. 203). Following a

Weberian tradition, the status groups forming these bureaucracies can be seen as sustaining

> a distinctive lifestyle and an output of co-ordinated, instrumentally relevant collective action [achieving and maintaining] a shared sense of what is involved in following rules: they achieve an agreement in their practice. What a rule 'in itself' cannot produce – a compelling indication of what is to follow in the next instance – can be produced by references to the rule in the context of the ongoing practice of the status group (Barnes, 1995, p. 204).

Bureaucracies and the rules that apparently structure their reproduction are hence maintained through conventionalities of meaning that are endorsed by authoritative status groups. The iron fist of the rule of law, one could say, is but a mirage of the soft social accords of a collective.

Through the insights of the performative theory of social institutions, an argument can be made for a secondary and much neglected etymological origin of regulation: to regulate is not only to govern by rules; it can also mean to make things regular or even. The point of regulation, in a sense, is neither to determine action nor to specify a mechanism of sanctioning. Written rules and the explicit elements of regulatory arrangements can be represented as rationalising instruments that allow agents to orient their actions according to particular conventionalities of practice. Rules and statutory arrangements do not determine in and of themselves behaviour. Rather, they are technologies of intervention, granting a veneer of objectivity to the actions of those who enforce the regulation and who implement punishment through the impersonal technicality of the rule and the juridical bureaucracies that support it. And as technologies of intervention, they are interpretative. The regularity that follows regulation is therefore not a result of correct rule-following as much as it is a reflection of the stability of meaning within a determined collective. Hence, when regulation 'works' it is not due to the linguistic or mechanical effectiveness of the rules comprising the regulatory network; it is, instead, an expression of the stability of epistemic and coercive authority, of meaning, and of practice.

Insofar as it entails stability, regulation necessitates some form of authority. For legal scholars, the nature of authority is given by wider legal doctrines to which the understanding of the rule of law and the role of the state are subordinated. For

them, the meaning and substance of authority is deduced almost self-evidently from the 'internal dynamic' of formalist jurisprudence (Bourdieu, 1987). For economic scholars, authority exists in the mechanics of the market where interest groups negotiate the shape of regulation through exchange. Hence, authority is closely associated to the capacity of actors to influence the outcomes of the political market for regulation. And for sociologists, authority is a force of coordination. In effect, as Michael Clarke argues, regulation is not merely a collection of rules and sanctioning mechanisms but is instead

> the constitution of a form of authority, whether internal or external, to achieve ordering in an area of life that has come to attention as showing tendencies to disorder, perversity or excess (Clarke, 2000, p. 3).

Sociologically, authority can be comprehended as existing in both overt and covert configurations, operating through monopolistic and distributed mechanisms of sanctioning, coercion and conventionality. The 'form of authority' invoked by Clarke therefore takes numerous shapes, from centralised bodies that dominate the mechanisms of punishment, to distributed systems of anonymous control, to status groups that organise knowledge and create power relations (Foucault, 1977), to the everyday normativities of social interaction (Goffman, 1990). Regulation, in a sense, is the process of making things regular.

In this chapter regulation is therefore interpreted in a broad sense. Regulation is not the mere establishment of rule-based systems. Rather, it is the mechanism through which the problem of authority is solved within collectives. Such problem, in particular, implies reaching agreement on the question of the legitimate arbiter for routine conflict, the establishment of deviations from the norm, the determination of the correctness of rule application, in sum, the regulation of activities, behaviours and relations. Regulation is hence both explicit rule-making and tacit regularisation, both normative coercion and conventional judgement.

Bearing the above in mind, I can proceed to represent the three epochs that framed regulatory action around the markets of the London Stock Exchange. As demonstrated in the following pages, regulation was a perennial characteristic of

economic life in the City of London, merely modifying its forms and modes of actions across time. The problem of authority, in a sense, was solved through different routes throughout the history of British finance, initially relying on the informal connectivities of the market (c. 1900) to eventually rely on statutory organisations built around both a carefully planned division of regulatory labour and the proliferation of technical instruments of intervention (c. 1986).

6.2 First epoch: interpersonal regulation through status groups

The first epoch of financial regulation in Britain corresponds to the period between the early nineteenth century and 1947, the year when the London Stock Exchange consolidated its ownership and membership through mutualisation. During the later part of this period (c. 1880 – 1940), the regulatory landscape of British finance was largely a mixture of litigation, jurisprudence and the administrative traditions invented with the rise of the Victorian regulatory state (Moran, 2003). Aside from a handful of Parliamentary Acts – including the Joint Stock Companies Act 1844, the Bankruptcy Acts 1830 and 1849 and the Companies Act 1862 – the City of London's markets were, in Moran's words, 'a study in cooperative regulation' (Moran, 2003, p. 52).

Organisationally, much of the routine regulatory work performed around the British securities market was the purview of the London Stock Exchange. Composed by brokers and jobbers (market-makers) who, up to 1947, were represented by the Committee on General Purposes, the membership of the Stock Exchange had unmediated access to the floor of the Stock Exchange where most of the trading in governmental bonds and corporate securities took place. Within the market, interpersonal forms of knowledge were paramount for engaging in transactions. Effectively, notions of trust, integrity and honour were central to both the inward representation and outward projection of the membership of the Stock Exchange (Preda, 2009). Consequently, and as Moran (1986) noted, much of the British system of regulation relied on trust of and between private members and institutions.

Owing to what amounted to a monopolistic position, the prime form of financial regulation during this epoch was manifested as the barriers of entry to the membership of the Stock Exchange. Notably, the *Rules and Regulations* of the Stock Exchange constituted the foremost regulatory instrument in the City of London: they defined not only the patterns of conduct within the organisation but, perhaps more importantly, the mechanisms of access to the community of the Stock Exchange and, consequently, the market. Merchant banks, for instance, were not allowed to participate of the membership; similarly, to obtain a nomination, individuals required the support of at least two existing members. Indeed, with the assent of the Treasury and the Bank of England, the *Rules and Regulations* of the Stock Exchange were generally considered a sound, almost legal, foundation for the constitution of a fair market.

Although intended as a formal device for surveillance and control, the rules and regulations of the Stock Exchange were everything but a body of explicit behavioural instructions. Much tacit knowledge about the customs of dealing was needed in order to carry out business on the Stock Exchange's trading floor and to resolve disputes between members. In his comprehensive *The Law and Practice of the Stock Exchange* of 1897, Spence Brodhurst highlighted the somewhat tacit conventionalities under which legal accords were forged. 'A contract made on the Stock Exchange', he wrote,

> embraces all the usual characteristics of a legally enforceable agreement, with such additions and alterations as the rules and customs peculiar to the market may introduce into all contracts which are concluded there (Brodhurst, 1897, p. 88).

While the 'reasonableness of the printed rules cannot be called into question', noted Brodhurst, the customs

> stand on a somewhat different footing. They are not expressly brought to the parties' notice in the ordinary course of business, but a knowledge of them is presumed from the fact that the parties are dealing in the market in which they obtain. So long as they are fair and reasonable a non-member is bound by them, although he was not aware of their existence at the time when he entered into the contract (Brodhurst, 1897, p. 89)[1].

[1] The conventionality of customs and their relation to wider legal orders was approached in *Robinson v. Mollett*:

The customs of the Stock Exchange were thus an informal and collectively distributed form of sense-making that shaped expectations of the behaviour of market participants. Specifically, such customs were the prime mechanism used by both market participants and governmental bodies to solve the problem of authority: in routine cases of conflict, arbitration was delegated onto the conventionalities of the market. In effect, for the government, the suitability of these customs and their associated rules and regulations was demonstrated by a noticeable lack of efforts to legislate on the activities of the secondary securities markets in Britain. Even when the markets were objects of governmental scrutiny, their operation was seldom condemned. In 1877, for instance, mounting political pressure led to a public inquiry into the constitution, customs and usages of the Stock Exchange. Rather than criticising the Stock Exchange for its restrictive practices, the Royal Commission thus formed provided credence to the organisation's existence. As Charles Duguid reported in 1913, few if any of the Commission's recommendations were implemented, perhaps owing to the positive opinions held by the Commissioners on the conduct of finance. 'In the main', wrote Duguid of the Commission's report, 'the existence of [the Stock Exchange] and the coercive action of its rules on its members [were considered] salutary and to the interests of the public' (Duguid, 1913, p. 126). For the Commission,

> the existing body of rules and regulations have been formed with much care, and are the result of long experience and the vigilant attention of a body of persons intimately acquainted with the needs and exigencies of the community for whom they have legislated. Any attempt to reduce these rules to the limits of the ordinary law of the land, or to abolish all checks and safeguards not to be found in that law, would in our opinion be detrimental to the honest and efficient conduct of business (Report of the Royal Commission on the Stock Exchange, quoted in Moran, 2003, p. 53).

When considerable numbers of men carry on one side of a particular business, they are apt to set up a custom which acts very much in favour of their side of the business. So long as they do not infringe some fundamental principle of right and wrong they may establish such a custom; but, if on dispute before a legal forum, it is found that they are endeavouring to enforce some rule of conduct which is so entirely in favour of their side that it is fundamentally unjust to the other side, the courts have always determined that such a custom, if sought to be enforced against a person in fact ignorant of it, is unreasonable, contrary to law, and void (in (Brodhurst, 1897)(p. 90))

Rather than constituting an authoritative regulatory intervention into the apparently opaque mechanisms of the Stock Exchange, the report of the Royal Commission provided implicit governmental acquiescence of the customs, rules and regulations of the organisation. In a sense, it made the Stock Exchange a *de facto,* if not *de jure,* regulator of the equities market in London.

If the *Rules and Regulations* of the Stock Exchange were accepted as a putative basis of control over the market, it was only because they reflected trust in the interpersonal connectivities of the finance[2]. Rather than operating as determinants of the behaviours of market participants, the *Rules and Regulations* served as both barriers to entry and apparatuses of justification for controlling the practices of those in the market. In a sense, they facilitated the outward projection of the Stock Exchange as a trustworthy community of intermediaries and the inward regulation of its members through informal control over trading and other social actions (Segre, 2008). New members were accepted only by nomination from existing ones. And existing members were required

> to have such personal knowledge of applicants whom they recommend, and of their past and present circumstances, as shall satisfy the committee as to their eligibility (Rule 25 as presented in Brodhurst, 1897).

Trust was of the essence. The communities formed by and within the membership of the Stock Exchange were as much a mode of guaranteeing external validation as an internal device for controlling and surveying the conduct of deals. Finance was, in many ways, a strictly personal affair. And amongst the jobbers and brokers of the Stock Exchange, words were, quite literally, the stuff of legal, enforceable bonds.

6.2.1 Dealing with speculation

The Stock Exchange, however, was not granted unlimited authority over the market. During the course of time, the Stock Exchange redefined its legal instruments and internal mechanisms according to an ever-changing body of case law. Litigation amongst clients and members shaped the legal regulatory frameworks for finance, as illustrated by the changing treatment of speculation within the financial communities of the Stock Exchange. A form of dealing that has strong cultural connotations of

[2] On social connectivities and the stability of finance, see chapter 5.

futility and gambling, speculation was the subject of much discussion and debate, mostly in connection to the trading of commodities and options. In the United Kingdom, legislation was introduced in the eighteenth century to deal with several forms of speculation. The Barnard Act 1734 specifically attempted to limit the ability of jobbers to profit from opportunities derived from buying or selling with the intent of making a quick return. Yet as the *New York Times* recalled in 1909, Barnard's Act 'became a dead letter within a few months after its enactment [for] dealers carried on their business as before, depending, for the security of their mutual obligations, not upon the law but upon the very conditions on which they dealt' (Johnson, 1908).

For some scholars, the Stock Exchange's treatment of speculation demonstrates the closed character of the organisation and its overt detachment from state regulation. In his criminological analysis of speculation, for instance, Christopher Stanley presented the City of London as

> an internally closed self-referential culture representing the consensus of the post-war settlement in economic relations. It had generated a set of internally coherent laws and norms of practice and behaviour which operated without reference to external validating authorities. In part this was a successful strategy which operated to persuade and coerce participants within a primarily domestic and limited financial market to abide by particular standards (Stanley, 1994, p. 238).

The literature on the Stock Exchange from the early 1900s would seem to confirm the predominance of an internalised approach to speculation. 'Unbridled and misguided speculation is at once dangerous and destructive', wrote F. E. Armstrong in *The Book of the Stock Exchange* in the 1930s, 'and it is the practice of the Stock Exchange to discourage such development [In] this [the Stock Exchange] has a difficult task, as the 'quality' of speculation is subtle and hard to define' (Armstrong, 1934, p. 129).

The impression that the Stock Exchange was a closed-world 'operating without reference to external validating authorities' as Stanley suggests is historically inaccurate, however. Although the Stock Exchange's capacity to coordinate the market was not seriously questioned by state institutions as demonstrated by the Royal Commission, conflicts occasionally reached the courts when the arbitration

mechanisms of the *Rules and Regulations* failed to produce agreements. Notably, issues such as the definition of speculation and its differentiation from gambling were supported by a well-known body of case law that resulted from a series of conflicts in which parties to transactions sought to avoid entering into contracts. By invoking a specific deal as gambling, a party to a contract could attempt to abolish his or her obligations. In his analysis of the cases brought to the courts up to 1897, Brodhurst concluded that

> it appears that although, if proved, it will be a complete defence to an action in respect of Stock Exchange transactions to allege that such transactions were not bond fide purchases and sales, but were merely by way of gaming and wagering, yet such an allegation is exceedingly difficult to substantiate, and, in the words of Lord McLaren in *Loioenfeld v. Hoicat*, the defence of gaming and wagering 'really does not offer to speculators in stock any available means of being released from their obligations' (Brodhurst, 1897).

Indeed, this legally supported tolerance to certain forms of speculation was not restricted to the community of the Stock Exchange. On the contrary, the dominant conceptualisation of speculation was constituted through the rhetoric repository of the juridical sphere, which classifies into case law new instances of market behaviour. The Stock Exchange, then, operated with reference to the exterior, constantly having to redraw the boundaries of finance, be it with the reinforcement of everyday rituals, the internal arbitration of conflicts or external litigation on the legality of contracts created on the trading floor.

6.3 Second epoch: self-regulating finance

The second epoch of financial regulation in Britain occurred between 1947 and 1986, years that marked profound changes in the governance structures of the securities industry. In particular, these years denoted the beginning and end of an era of government-sanctioned self-regulation within the City of London.

In 1947, British finance faced two important events. The first was the mutualisation of the London Stock Exchange. Compelled by the threat of nationalisation – which had placed the Bank of England under government control – the membership of the Stock Exchange took over the ownership of the organisation, thus consolidating the market and its regulation under a single roof.

The second event was the legislative transformation of the prevailing regime of corporate law and the concomitant invention of the moral imperative of 'investor protection'. As other areas of British industrial policy, corporate governance was no stranger to the delicate balance between legislative change and informal regulation. Following trends from the previous century, in 1900 parliamentary action required shareholders to appoint auditors to oversee the company's balance sheets; in 1908/9, the distinction between public and private companies was established; and in 1925, profit and loss accounts were enforced, although these had to be neither audited nor registered. By 1943, the Board of Trade – the key regulatory agency for companies – initiated inquiries into possible legislative reforms of the Companies Act 1929 then in force, appointing Justice Cohen to chair an inquiry on the state of corporate governance.

The report of the Cohen Committee thus became the foundation of the Companies Act 1947, consolidated in the Companies Act 1948. Writing in *The Accounting Review* of 1946, Mary Murphy deemed that the Committee rightfully envisaged 'the necessity of protecting the investor and enhancing his control over company managements without imposing unreasonable restraints upon ethical business' (Murphy, 1946, p. 37). The relevance of the Committee's findings lay not in proposing a mere technical update of the existing regulation but rather in the recognition of an

> increasing distribution of savings among persons totally unfamiliar with the responsibilities of investment [which] leads to acceptance of the premise that investors must receive both legal protection against fraud and adequate data concerning their companies' financial positions and operating results (Murphy, 1946, p. 38).

In the imaginary forwarded by the Committee and shared widely across the City of London, finance was becoming popular, and with this popularity, provisions were needed to safeguard the uninformed and inexperienced investor. Replicating this imaginary in 1951, the Stock Exchange gave credence to its existence: there were very few people in Britain, it argued, who were not 'interested in and dependent upon the Stock Exchange either directly or indirectly and in one way or another' (The Council of the Stock Exchange, 1951, p. 4). The state and City had thus a new

responsibility: to protect and guarantee the rights of investors in order to foster trust in the financial marketplace as the quickest, cheapest and fairest mechanism for providing new capital without which 'our present standard of living could not be maintained' (The Council of the Stock Exchange, 1951, p. 10).

In this regulatory epoch, trust became a recognised instrument for mediating the relations of an increasingly bureaucratic organisation – the mutualised London Stock Exchange – and a changing public sphere. The solution to the problem of authority (and hence, the shape of regulatory action) thus boiled down to delegating authority onto the Stock Exchange and crafting an institutional persona based on vocabularies of trust, duty and investor protection[3]. Unlike the previous epoch where this delegation of authority was informal and occurred through the social networks of finance, in this second epoch the delegation was overt and centred on an emerging suite of formal institutional mechanisms within the City of London.

As the moral imperative for regulation during this epoch, investor protection was construed as a substantial increase in accounting and audit requirements. Inspired by the recommendations of the Institute of Chartered Accountants of England and Wales, the disclosure standards introduced by the Companies Act 1948 provided a clearer framework for the presentation of company accounts (Edwards, 1989). Overall, however, the listing and disclosure requirements of the Stock Exchange always exceeded those set by the Act. In effect, the new legislation provided weight to, and further articulated, the authority of the Stock Exchange. The report of the Cohen Committee considered affordances for

[3] As Josephine Matlby noted in her study of British corporate law, the Companies Act 1948 was not a legislative revolution in favour of greater corporate responsibility towards society at large but was instead a move to make regulations responsive to the needs of shareholders (Maltby, 2000). The Act, however, embodied an important discursive innovation: namely, the invention of investor protection as a moral imperative for governmental, industrial and financial circles. The conceptualisation of investor protection as the aim of informal regulation was more a product of the rhetoric of an expanding market rather than the reflection of changing patterns in the ownership of shares in the United Kingdom. In contrast to the dispersed modes of corporate ownership that developed in the United States between the 1930s and 1940s – that is, the emergence and materialisation of the Berle-Means corporation –, British companies remained controlled predominantly by small groups that "retained a sizable percentage of the shares and played a prominent role in managerial decision-making" (Cheffins, 2003, p. 12). Investor protection remained the protection of a handful of powerful shareholders rather than the protection of some wider – and unidentified – section of society.

> a division of labour between legislative regulation of the Companies Act and administrative control through the London Stock Exchange Council and the Board of Trade (Anonymous, 1947, p. 1384).

And with the enactment of the Companies Act 1948, the London Stock Exchange gained an additional role as a recognised listing authority for new securities (Wrenbury, 1949).

While the reliability of the primary market was secured through the Companies Act 1948, the stability of the Stock Exchange's social networks was also strengthened through government interference. In 1938, in particular, the government responded to increasing discontent with the practices of dealers who worked outside the membership of the Stock Exchange. Through a Departmental Committee, the Board of Trade looked into the practices of share pushing and share-hawking. And as demonstrated by their report, for the members of the committee the issue of deceptive practices was reduced to the trust created by professional demarcations in finance. 'So long as anybody, however impecunious or inexperienced he may be, can call himself a 'stockbroker'', read the conclusions of the committee, 'there will be grave and obvious risk of losses inflicted on the ignorant public' (Report on Share Pushing, cited in Mannheim, 2001, p. 124). In the interest of investor protection, the ensuing legislative process made dealing a licensed activity and to deal without a license a criminal offense.

In spirit, the Prevention of Fraud (Investments) Act 1939 thus introduced resembled an entirely modern instrument of government-led regulation; regulation, that is, understood as the extension of government control over the affairs of private business. As Hermann Mannheim observed in 1946, the act empowered an agency of the state – the Board of Trade – to issue orders endorsed by penal action (Mannheim, 2001, p. 124-125). The main contribution of the 1939 Act and its revised 1951 version was nevertheless to reinforce the prevailing system of informal regulation and oversight. Specifically, although the Act required dealers in securities to register and obtain a license, it contemplated exemptions for recognised stock exchanges and associations of dealers in securities. Although the Act did not *prima facie* exempt members of the Stock Exchange from licensing (it considered revoking exemptions

by order of the Board of Trade), never was the authority and trustworthiness of the Stock Exchange seriously questioned. In practice, by defining administrative controls over the professional boundaries of securities dealing and by granting exemption to the Stock Exchange, the Act gave legislative form to financial self-regulation.

A new division of regulatory labour hence emerged: while the professional conventionalities of accountants and the administrative oversight of the Board of Trade would care for the disclosure of company information, the organisational barriers of the Stock Exchange's rules would guarantee the quality of the market and of the entities therein traded. Investor protection derived from trust in the system of relations that gave credence to and stabilised the practices and institutions of finance in the City of London rather than from the apparatus of state control and surveillance. And here, through the division between brokers and jobbers, the Council of the Stock Exchange's oversight coupled to the material character of the trading floor was the foremost technology of surveillance in British finance:

> [an advantage] of the an open outcry floor in those days was that one of the roles [the jobbers] did exceedingly effectively [was that] they had a very good ideas as to who was honest and who was dishonest, and they would tell you to mind your eye if they thought that there was anything unusual going on. So it was a self-policing mechanism […] It was an absolute eye opener to me when I first went on the council as to what some firms got up to. As the English proverb [says], birds of a feather flock together. In other words, there were half a dozen firms which if there were going to be problems the chances were they were there as it were. If there was going to be something approaching dishonesty that's where you'd find it. (Ross-Russell interview)

And so, when the Stock Exchange published the brochure *My Word is My Bond* in 1951, in did not exaggerate by opening with the words 'The Stock Exchange is a national institution' (The Council of the Stock Exchange, 1951). They were, in all relevant ways, the recognised regulatory centre of British finance.

6.3.1 Mergers & Acquisitions

The choice of informal self-regulation as a solution to the problem of authority was made evident by the handling of a drastic increase in corporate mergers in late 1960s Britain. Propelled by favourable post-war economic conditions and the enhanced financial disclosure requirements of the Companies Act 1948 (Roberts, 1992), hostile takeovers became a particularly acrimonious issue populating the pages of the British

financial press. These activities, however, were formally unregulated, with provisions lacking both in the existing legislation as in the rules and regulations of the Stock Exchange. As Richard Spiegelberg noted in his critical assessment,

> all attempts so far to regulate the conduct of City institutions in take-over situations have to be seen as a compromise between, on the one hand, the desire for freedom and flexibility, and on the other, the need to ensure that the ethics and reputation of the City as a while are not seen to be question (Spiegelberg, 1973, p. 171).

A series of highly publicised cases between 1966 and 1967 proved impossible to manage via the social connectivities of the City of London, and in 1967 the Governor of the Bank of England, along with the Chairmen of the Issuing Houses Association and the London Stock Exchange, convened a Panel to supervise the operation of a Code on Amalgamations and Mergers. A crisis of public confidence had thus led to an overhaul in the regulatory system. Formed by City insiders, the resulting Panel on Takeovers and Mergers was and remains the administrative agency behind the Code and its application.

The Panel was a compromise between the incumbent system of informal regulation through social networks and market conventionalities and broader calls for statutory oversight. On one hand, the Panel on Takeovers was designed as a formal body invested with specific responsibilities over matters relating to mergers and acquisitions. On the other hand, the Panel continued a logic of laissez faire, delegating regulatory action on established self-regulatory institutions. As Spiegelberg noted in 1973 that

> the fundamental flaw in the new system consisted simply in that [the Panel] was itself virtually powerless […] The Panel's censure was a dubious dishonour just as the freedom from an obscure American town in the mid-west may be a dubious distinction (Spiegelberg, 1973, p. 177, 179).

Indeed, after a difficult and highly criticised first year of operation, the Panel had to review the Code and its implementation. Rather than establishing an independent regulatory body, the Panel used the bureaucratic mechanisms and coercive authority of the Stock Exchange and the Board of Trade to intervene in conflicts: while the former had the ability to censure, suspend or expel companies from the official list, the latter could revoke the licenses of dealers (Armour & Skeel, 2006).

The Panel on Takeovers therefore represented three regulatory innovations. First, it demonstrated that indirect forms of coercion can be mobilised and exerted through social connectivities without the overt intervention of an independent statutory agency (see (see Johnston, 2007 for further details) for further details). Second, while it operated on the periphery of the juridical field, the Panel served as a forum for negotiating and reconstituting the meaning of self-regulation, the conventions of finance, and the acceptable modes of intervention in the market. And third, the Panel fostered the acquisition of regulatory expertise through the experience of discussing, evaluating and implementing the Code. In a finitist sense, the Panel was a place for training future regulators.

6.4 Third epoch: the road to statutory regulation

The third epoch of financial regulation corresponded to the period between 1986 and 2000, marked by the introduction of the Securities and Investments Board and the broader consolidation of statutory oversight and technical intervention in the activities of the City of London. The seed of this epoch was a crisis of legitimacy planted in 1971 when merchant banks and institutional investors challenged the system of fixed commissions of the Stock Exchange. On that year, the Accepting Houses Committee – formed by merchant banks that were excluded from the Stock Exchange membership – announced the introduction of a computerised trading system that could bypass the trading floor of the Exchange. The system, known as the Automated Real-time Investments Exchange Limited or ARIEL, became the centre of an acrimonious debate between the Stock Exchange and the City at large.

The debate surrounding ARIEL eventually resulted in a wider recognition that the 'traditional' boundaries between banking and financial services were being breached. In an attempt to preserve the self-regulatory environment of the City of London, the Stock Exchange and the Accepting Houses Committee sought to establish a body acknowledged and supported by all practitioners in the securities industry 'which would bring the two sides closer together and which could also possibly fend off the unwanted attentions of Government' (Hamilton, 1986, p. 7). The proposed organisation, the Securities Industry Supervisory BOard, SISBO, would

‘supervise the functions of the securities industry, the markets and their practitioners in the public interest [with its] authority [being] implicit in the general acceptance of its status’ (SISBO Objectives, quoted in Hamilton, 1986, p. 177, 179).

The Bank of England and the Department of Trade and Industry (which succeeded the Board of Trade in 1970) reacted cautiously to SISBO. For them, the conflict between the Stock Exchange and its clients became an opportunity for government intervention. In October 1979, the Secretary of State for Trade announced a governmental review of the securities industry, hence overshadowing the creation of SISBO. Effectively, the practitioners’ body eventually formed – the Council for the Securities Industry – was constituted with limited authority (Hamilton, 1986, p. 9): following the template of the Panel on Takeovers, the CSI’s activities were restricted to issuing a Code of Conduct of Dealers in Securities and reviewing the practices of investment managers in 1979. The enforceability of the Code of Conduct was nevertheless questionable since the CSI was had no formal powers, no permanent staff (Black, 1997) and was eclipsed by larger governmental ambitions.

Government pressure coalesced as early as 1974, when the Department of Trade and Industry, DTI, requested the Stock Exchange to register its *Rules and Regulations*, along with its Code of Dealing, with the Office of Fair Trading. The practices of the Stock Exchange, the customs once deemed a sound basis for finance, were on their way to the Restrictive Practices Court.

Talk of reform remained in the air, and in 1981 the Secretary of State for Trade and Industry commissioned a review of the statutory protection required by private and business investors in securities and other property, the need for statutory control of dealers in securities, investment consultants and investment managers, and advice on the need for new regulation. Written by L.C.B Gower, the report published in 1984 as the *Review of Investor Protection* became the basis for the introduction of a legislative overhaul, the Financial Services Act 1986.

The Gower Report provided an account of the state of regulation in the British securities industry of the early 1980s, offering suggestions on the possible content and reach of future legislation. Although it stands in public memory as the forerunner of the revolutionary Financial Services Act 1986, in its proposals, the Gower Report maintained a strong continuity with the past. Following the conventional vocabulary of British finance, the report considered regulation reducible to the implementation of a system 'which would help the public to identify the sheep and which will effectively curve the activities of the goats' (Gower, 1984, p. 5). Self-regulation was not an object of critique in the report. For Gower, the fault of the existing system 'has not been that of self-regulation as such but of self-regulation not subject to effective surveillance and [in some cases] of the absence of any prudential regulation whether self or otherwise' (Gower, 1984, p. 5). Indeed, the Gower report presented statutory regulation as a potential hindrance: in the interest of convenience, efficiency and economy, intervention in the market 'should be reduced to the minimum necessary adequately to protect investors' (Gower, 1984, p. 5).

Partly inspired by the Gower Report, the Financial Services Act 1986 established government-sanctioned demarcations that were in line with the previously accepted boundaries of financial regulation in Britain (Coopers & Lybrand, 1988). The Act, in a sense, was not entirely discontinuous with past modes of self-regulation. On the contrary, the Act cemented existing relations in statutory law. Thus, rather than granting the Stock Exchange *ad hoc* privileges, the Act created two general legal entities, the Self-Regulatory Organisation and the Recognised Investment Exchange, that conformed to preceding usages and customs.

The Act, however, rationalised the division of regulatory labour in British finance. Thus, while as a recognised investment exchange the Stock Exchange would manage the day-to-day supervision of the market, the newly formed Securities Association would determine the specific content of regulations. Professional demarcations were likewise legalised with the invention of Recognised Professional Bodies. Control over the markets was delegated to a 'designated Agency', the

Securities and Investments Board, responsible for patrolling the integrity of the City on behalf of the DTI. Even the social connectivities of finance were rationalised: established when the Stock Exchange transformed individual into corporate membership, the Securities & Investment Institute served as a professional association that kept tabs on 'people's integrity and [made] sure that this was emphasised [in the future]' (Ross-Russell interview). The Act and its correlates divided regulatory labour across a collection of increasingly bureaucratic and formal organisations (White, 1984).

Contrary to the traditional account, then, British finance in the 1980s was oblivious to deregulation in a strict, etymological sense. Although it is often said that the events surrounding the Stock Exchange's Big Bang exemplified a global trend towards deregulation (Plender, 1987), both in quantity and in quality, the rules, regulations, codes, guidelines and mechanisms of surveillance that populated the City of London grew around the constitution of the Financial Services Act 1986. 'Had a Socialist administration tried to introduce similar reforms', wrote Michael Moran, 'the response would have been uproar in the Conservative benches and apoplexy in the City' (Moran, 1988, p. 20). Regulation became 'a lawyer's paradise'. The new system was

> extremely legalistic, and given the interests at stake it is likely to be tested in court on many occasions […] Substantial new sources of income are arising for the legal profession in fighting cases related to the FSA, in working for regulatory organisations, and in acting in the compliance field in financial institutions (Lomax, 1987, p. 201-202).

As Harold Wilson wrote to Margaret Thatcher, almost everything the Stock Exchange did as a financial institution 'has now got to be transacted under the eyes of solicitors and barristers' (Wilson quoted in Kynaston, 2002, p. 618).

Solicitors and legal experts were not the only ones to claim regulatory competencies. The technological reconfiguration and expansion of the market in the 1970s and 1980s resulted in a vast machinery of command and control. It was not infrequent to read, for instance, that the quote and price dissemination technologies developed by the Stock Exchange in preparation for Big Bang were 'a complete system of surveillance' enabling suspicious circumstances or public complaints to be

fully investigated (Goodison, 1986b). The technologists behind these innovations were, indeed, regulators of sorts. Peter Cox, who spearheaded the creation of the successful international equities trading system, SEAQ-I, is an example. By coordinating diverse participants, he obtained agreement on the conventions of trading that would found exchange amongst foreign institutions that otherwise distrusted London (chapter 4). Others, such as Peter Bennett, architect of the Stock Exchange's technological platforms, worked on the creation of technical and organisational standards for the establishment of Euroquote, a pan-European trading platform. By setting policy and participating in the construction of the supports of British finance, the technologists at the Stock Exchange regulated: they generated patterns of expected behaviour for market participants, protocols that users 'had' to follow for the 'correct' operation of the market.

As an institution, the Stock Exchange was also increasingly technical in its self-assessment. Gauging the state of the market through the social connectivities of the trading floor was replaced by the formality of numbers and statistics. Increasingly, quantitative analyses became rightful instruments for accessing, representing and intervening in the market. Notably, from 1986 onwards, the Stock Exchange invested an increasing amount of organisational efforts in conducting statistical and economic studies of the market, from analyses of the number of market-makers in UK equities to detailed research into the costs of dealing and the factors affecting bid-ask spreads (Quality of Markets Unit, 1986a). Economics had reached market institutions, converted into a legitimate tool of analysis and intervention.

Importantly, the proliferation of technical instruments did not imply the mechanisation of rule following. For the most part, regulatory action remained anchored to situated finitist judgements[4]. As in the past, rule application required

[4] Throughout this volume, I have sought to represent knowledge through the theoretical perspective of the Edinburgh school of the sociology of scientific knowledge. For the Edinburgh school, knowledge and concept application should not be read as governed by objective rule following. Rather, concept application moves from case to case, 'mediated by a complex judgments of similarity and difference, and informed at all points by the local purposes of the concept users' (Bloor, 1991, p. 164). Concept application – which includes determining whether someone broke or not a rule – is therefore

contingent forms of knowledge and authority. Daniel Sheridan, who oversaw market regulation in the Stock Exchange in the years surrounding Big Bang, highlighted the nature of rules in the new environment:

> If there was a really big deal going on in London, the broker or the jobber or the […] merchant bank would come and see me and would talk about the nature of the deal they were going to undertake and would ask for an interpretation of the rules within the context of that type of deal. And I had an enormous amount of flexibility for, I wouldn't say vary the rules, but to interpret the rules to accord with certain things. And I had enough experience to make sure that other firms didn't lose out […] and I got a reputation for being able to do that. All the jobbers trusted me, they knew that I wouldn't disclose their business to anyone else. And all the brokers trusted me, including the small country brokers. The regulatory infrastructure that [was] set up was not one you'd find anywhere else in the world (Sheridan interview).

Flexibility, however, was a right founded upon relations of trust established between market participants. The right to regulate required expertise of a certain type. Regulating thus transcended enforcement; rather, it called for a coherent understanding of individual contexts in which rules were created and deployed, an understanding, in a sense, of the particular configurations of communitarian authority[5] (Kusch, 2002). 'If you're not responsible for creating [the rules], if you're simply a regulator', recalled Sheridan, 'then everyone out there thinks their interpretation is as good as yours' (Sheridan interview). Discretion remained, albeit veiled by a growing set of technical instruments.

6.4.1 Markets made transparent

An important change occurred, however, within the increasingly fragmented and rationalised institutions of British finance. The adoption of novel instruments for market analysis—including economics as a tool of intervention and digital technologies as platforms of exchange—facilitated representing the market as an informatic entity that could be managed and control through technical means.

---

underdetermined by explicit norms and relies on forms the experience of whoever it is that is applying the 'rule'. In this sense, it is a 'situated' process, insofar as it is influenced by the situation and the locality of the moment in which the concept is applied.

[5] By communitarian authority, I refer to forms of power that are distributed throughout a particular group and that are only manifested collectively. Thus, they are represented by the shared instruments of coercion and sanctioning and the collective norms that are associated to them. In this sense, understanding how the community acts towards particular rules is an integral part of the regulator's judgement.

Consequently, market design, surveillance and oversight could be rationalised according to the models, accounting techniques, and statistical comparisons that comprised the technical systems of the new epoch; the problem of regulatory authority was resolved, in a sense, by transferring control to instruments of market representation.

This phenomenon was particularly noticeable in the regulatory approach of the Office of Fair Trading. Subordinated to the Department of Trade and Industry, the OFT neither dictated nor enforced regulations on the Stock Exchange and its member firms. Rather, its role was to 'substantially change the playing field and the rules, perhaps forcing the unbundling of […] charges, particularly to non-member firms, and threatening [the Stock Exchange's] primary market function' (Lynch, 1989b). As the foremost advisor to the state in matters of industrial regulation, the Office of Fair Trading had a direct bearing on the meaning, content and legal forms of public policy.

Towards the late 1980s, the OFT established concrete relations with the growing communities of British economists interested in issues of markets, efficiency and competition. Notable among these communities was the London Business School, the Financial Markets Group of the London School of Economics (established in 1987), and the City University. Fuelled by the growth of global circuits of economic expertise, these research centres became focal point of economic knowledge in Britain (Thrift, 2005). From these points, the OFT derived a novel suite of theoretical instruments, a new vocabulary for approaching and regulating the market.

The type of analytical instruments enrolled by the OFT is exemplified in the work of John Kay and John Vickers[6]. In a review written in 1988, Kay and Vickers provided an assessment of the so-called British 'regulatory reform' of the 1980s, arguing that the system instituted by the Financial Services Act was inappropriate for

[6] Incidentally, at the time the paper was produced, Kay worked at the London Business School while Vickers worked at Nuffield College, Oxford. Vickers, in particular, later served as Director General of the Office of Fair Trading between 2000 and 2005.

the operation of the market. For Kay and Vickers, the issue was not refining the relative balance between statutory and self-regulation. On the contrary, in their opinion regulatory work should focus on two endemic features of financial markets unattended by policy: asymmetric information and public confidence in the system in its entirety. 'To the extent that asymmetric information is the problem', they wrote, 'the first response must be to improve information flows. This implies the more extensive disclosure and the maximum transparency for market dealings' (Kay & Vickers, 1988). Regulation, surmised a growing number of economists, was about the control and management of information rather than the control of membership, the reinforcement of trust and the adjudication of rights.

Apprehended by the OFT, this new vocabulary tested the Stock Exchange's strategy. In April 1988, the Office of Fair Trading published a review of the rules that formed part of the Stock Exchange's bid to the Securities and Investment Board in seeking recognition as an RIE under the Financial Services Act. For the Director General of the OFT, 'the major anti-competitive features to which I objected in the old exchange's rules' had gone (Office of Fair Trading, 1988a, p. 2). There remained, however, several points of concern. The introduction of new trading platforms in the London Stock Exchange in 1986 – notably SEAQ, the bidirectional quote dissemination system; TOPIC, the general online information system; and CNS, the company announcements service – resulted in a visible centralisation of information provision. The Director General articulated a new regulatory preoccupation, namely, that the Stock Exchange had generated a monopoly of information by conflating its roles as regulator, dealing platform and information provider for the marketplace.

In response to the April 1988 report, the OFT issued detailed advice on the Stock Exchange's information services. For the OFT, the problem was reducible to 'the Stock Exchange's decision that it should, in effect, be the sole source of domestic company news' (Office of Fair Trading, 1988b, p. 2). For the Stock Exchange, the sole source approach was necessary to prevent the disorderly or improper release of information. But for the Director General of the OFT, the

mechanisms put in place by the Stock Exchange discriminated commercial information vendors, utilised restrictive policies on the re-use of information, cross-subsidised regulatory and commercial roles, and allocated costs without reference to the benefits received. By doing so, the Stock Exchange 'restricted, distorted and prevented competition in the market for company news' (Office of Fair Trading, 1988b, p. 4).

The Stock Exchange was not oblivious of these problems, and prior to the OFT's June 1988 report planned the introduction of two new systems, the Regulatory News Service and the Commercial Company News Service. These would operate independently in order to avoid cross-subsidisation, providing equality of access to data feed of company news. The Stock Exchange, however, remained strongly committed to its role as a sole source of information. In a multi-source system, they argued,

> - There would be no validation of announcements, or elaborate rules would be required which would be difficult to enforce.
>
> - There would be a disorderly release of information, i.e. there would be no control over the priority of release, and information would be likely to appear on different information services at different times (Office of Fair Trading, 1988b, p. 23).

While the securities markets remained concentrated in London, and while the Stock Exchange remained the country's listing authority, the sole-source approach was deemed imperative for guaranteeing the value and authenticity of information.

The OFT was unconvinced. Although it acknowledged the importance of the quality of information, it cited the provisions of the Financial Services Act relating to Recognised Investment Exchanges. As the OFT noted,

> where relevant, require issuers of investments dealt in on the exchange to comply with such obligations as will, so far as possible, afford to persons dealing in the investments proper information for determining their current value (Office of Fair Trading, 1988b, p. 14-15).

For the OFT, the mechanisms established by the Stock Exchange failed to provide the affordances envisioned in the legislation. Although the sole-source might provide some benefits to the users of the market, it was 'not necessarily the best way to achieve fairness. It may control the flow of information and ensure that it reaches

those who can afford to subscribe to the Exchange's service […] but it does not ensure that information reaches the wider audience of private shareholders' (Office of Fair Trading, 1988b, p. 26).

Through their assessments, the OFT exemplified a transformation of the regulatory imperatives of British finance. The economic vocabularies of information asymmetry and market transparency were becoming the technical manifestations and measures of previous notions of investor protection. As equal access to information became a right of the marketplace, transparency became its technical expression. Moral and interpersonally evaluated rights were made amenable to the mechanics of mathematical formalism.

Following a period of extreme competition amongst market makers, in 1989 the Stock Exchange revised its rules on the publication of deals. After Big Bang in 1986, trades in the most active stocks (also known as 'alpha' stocks) were reported within five minutes of execution and published immediately thereafter. Reporting in the less active 'beta' stocks was not required, though. The revised rules, however, extended immediate publication to beta stocks and introduced a 24 hour delay in the publication of large deals: £50,000 for beta stocks and £100,000 for alpha stocks. Based on a study commissioned to the London Business School, the Stock Exchange considered such delay would give market makers the opportunity to unwind their positions without generating 'spurious' volatility in the market (Lee, 2002, p. 181). It was, for them, the reasonable mechanism for guaranteeing an orderly market.

In their subsequent assessment of the amended trading rules, the OFT presented a different interpretation, arguing that delays in publication created information asymmetries that restricted and distorted competition (Office of Fair Trading, 1990, p. 5). Crucially, the OFT's opinion was based as much on the standard process of consultation with market participants as on economic research. In preparing their report, the OFT commissioned Professor Gordon Gemmill of the City University Business School to study the effects of different publication rules on large trades (Gemmill, 1996; Office of Fair Trading, 1990). As Gemmill recalled, the

'official' character of the study provided him with access to trade-by-trade data 'which would otherwise not have been available to me' (Gemmill, personal communication). In effect, the OFT report not only created a new object of regulation – price transparency; it also materialised a regulatory turn towards economic evidence in quantifying and qualifying competition in the market.

Issues of price transparency continued to figure heavily in the interactions between the OFT and the Stock Exchange. In 1991, the Stock Exchange changed its rules by dismantling the existing categorisation of shares and introducing the Normal Market Size[7] as the new metric for stocks. In an attempt to provide a better proxy for liquidity, reporting standards were now framed through NMS rather than in terms of the previous categories alpha, beta, gamma and delta (Lee, 2002). In their assessment of these changes, the OFT once again turned to the instruments of economics. The report published in November 1994 was notably technical. Transparency, it argued, had a clear economic justification:

> Prices are regarded as efficient if they reflect all available information. This is the basis for the efficient markets hypothesis (EMH) which suggests that stock prices take account of certain kinds of information, essentially public information, efficiently, that is, in such a way that one cannot make exceptional profits by using the information. The implication of this is that pricing efficiency can be enhanced if relevant information is revealed to the market. Immediate last-trade publication can contribute to pricing efficiency if details of past trades convey information to the market (Office of Fair Trading, 1994).

In light of a growing literature, the OFT reaffirmed its previous findings, arguing that delayed publication restricted and distorted competition. Transparency had become a technical metaphor for regulation in the City of London.

In May 1997, after the protracted collapse of the Bank of Credit and Commerce International, the Chancellor of the Exchequer, Gordon Brown, announced an overhaul of British banking, insurance and financial services. Barely ten years had passed since Big Bang when the responsibility to supervise the financial services sector was delegated to a new agency. From 2000 onwards, the

[7] A measure based on the average transaction size for each stock over the previous 12 months of trading

Financial Services Authority, successor to the Securities and Investment Board, thus became the central, statutory regulator of British finance.

Legislated through the Financial Services and Markets Act 2000, the Financial Services Authority acquired statutory control over the market. The FSA thus became a governmental mechanism for guaranteeing market confidence, public awareness, consumer protection and lower levels of financial crime. In a sense, the FSA was but a result of trends initiated in the 1980s, when technicality rose to prominence as a legitimate form of regulatory intervention. Specifically, the authority of the FSA was partly anchored on the expert tools of economics: within its remit, the regulator was given the authority to make rules 'about the disclosure and use of information held by an authorised person' (S. 147 HM Stationary Office, 2000). The regulation of finance was thereby extended to the surveillance, control and regulation of information.

6.5 Final remarks

The regulatory landscape of British finance is once again undergoing a process of change. Catalysed by the recent financial crisis, the role, operation and instrumentalia of regulatory institutions is at centre of the domestic and international political debate. Many questions remain on the shape that future regulation will take. What transformations, if any, will characterise the next epoch of financial regulation?

The debate between Lord Turner and the Treasury Committee in June 2009 gestures, perchance subtly, at probable points of fracture in the current regulatory regime. Importantly, the incumbent economic paradigm is the target of intense critique. In reflecting on the crisis, for instance, Lord Turner noted in his speech to the CBI's Annual Conference that

> too much confidence in the theory of efficient and rational markets, in the assumption that liquid financial markets will deliver appropriate price signals which give warning of risk, and that private incentives and market discipline will ensure that beneficial and adequately stable results follow from the pursuit of competitive self-interest […] Alan Greenspan believed that theory explicitly and strongly for over 40 years up until last year. And then, on 23 October last year, he informed the world that having observed the crisis and

> thought a bit more about it, 'I have found a flaw' […] The flaws are indeed many and significant (Turner, 2009).

The future of regulation according to Lord Turner resides in a novel philosophy that focuses on 'systemic approaches' rather than technical risks measured at the level of the firm. The future, for Lord Turner, is in a conservative regulation of complexity. The techniques behind such approach, behind an emphasis on the system rather than the firm, have yet to acquire the concreteness of the regnant economic paradigm, however. Before financial economics reached the ears of the OFT, we must remember that it produced a canon (Jovanovic, 2008), it became a global source of authoritative expertise on the market.

The coin is in the air, then, on the economic paradigm that will instrument future regulation. Notably, though, potential candidates are increasingly discernable. In a note provokingly titled 'The Economist's New Clothes', Stephanie Flanders, the BBC's chief economic editor, explored three approaches that are competing for the attention of the regulators of the future. Neoclassical economics, as represented by Myron Scholes, seems 'pretty unrepentant', unlikely to change its customs and approach (The Economist, 2009). Keynesianism as heralded by Lord Robert Skydelsky attracts great interest, noting the irreducibility of the world to probabilistic relations. And behavioural economics, as construed by Richard Thaler, brings the promise of empirical insights – though, as Flanders notes, behavioural economics is more critique than competing theory (Flanders, 2009).

Behind the debate, however, one thing is almost certain–or as certain as things can be in finance. The extant organisational trends that represent markets as manageable activity, as entities that can be fixed through intervention, are likely to continue. Crisis once again confirmed its role as a motor of reregulation. And whilst some regulators call for greater discretion and less reliance on technical instruments, the bureaucracies of market surveillance and control are likely to grow. Interestingly, though, as the dust of the last crisis settles, a new set of challenges is emerging in the horizon. Technological innovations in finance, specifically the proliferation of sophisticated computer systems that automate trades and conduct deals within milliseconds, are transforming the structure and behaviour of the markets. Perhaps

ironically, as markets overtly become domains of computational interaction, regulation is claiming to move away from technicality, attempting to recover a role for individual judgement and institutional discretion.

metaphors

7 The Fuzzy Ontology of Finance: Making Markets with Metaphors

In the atrium of the London Stock Exchange building stands a 32 meter-tall artefact animated by the live data feeds of electronic trading. Inaugurated by Her Majesty Queen Elizabeth on 27 July 2004, the 729 Perspex orbs of *The Source* – a kinetic sculpture designed by greyworld – move up and down, activated by Python scripts that capture, interpret and represent the market's activity as it takes place. Like pixels on a screen, *The Source* makes physical the ephemeral nature of the stock market, providing the Stock Exchange with a unique digital substitute for its lost trading floor.

The Source is an homage to both the electronic fluidity of the market and the human buzz of a time long gone. In its futuristic constitution, however, *The Source* annihilates nostalgia, creating a space – both economic and architectural– that leaves no room for the past. Aside from the Perspex – material of both *The Source*'s orbs and the whiteboards that once stood on the wooden floorboards near Threadneedle Street – nothing seems to remain from the days of analog finance. The pristine metal and concrete, marble and glass of the new Stock Exchange building surgically reconstruct our social imaginary of the market, reminding us that in today's financial word there is only the cold reality of the corporate future.

The Stock Exchange, nevertheless, shares a distinctive feature with its predecessor. Like the Starbucks across Paternoster Square, the newsstand at the entrance of Bank station, the art gallery in Soho, the Tesco near Pall Mall, the Stock Exchange is a space of economic interaction, an arena for trade. The Stock Exchange, in particular, is a market, and despite the transformations and vicissitudes of time, has been so constantly for more than two hundred years.

The market, we are told, is a cornerstone of modernity. Through it, goods and services are allocated, labour is directed towards productive ends, natural resources

are transformed into sophisticated products, and innovation is guaranteed by the spirit of capitalist enterprise. Whether through its invisible hand, its rationalising logic, or its evolutionary mechanics, the market shapes, organises and structures society.

Despite this centrality, the market seems to escape all efforts of definition. Throughout the literature, the market emerges as a chameleonic character whose role adapts to the analytical gaze of the audience. The market is fluid circulation and static calculation, creation and destruction, mechanism and organism. The market is impersonal exchange; an aggregator of knowledge (Hayek, 1948); a Delphic oracle (Wolfers & Zitzewitz, 2004); the disentanglement of ownership relations (Thomas, 1991); a system of commensuration (Carruthers et al., 1999); a calculative device (Muniesa & Callon, 2005); a frame for embedding and disembedding (Callon, 1998); networks of social relationships between producers and consumers (Granovetter, 1985); collectives differentiated through boundaries of legitimacy (Preda, 2009; Podolny, 1993); signalling systems (White, 2002); conversational exchanges (Knorr Cetina et al., 2002); a social arena of structured exchange (Fligstein, 2001); an evolving computational entity (Mirowski, 2007); a mechanism for the creation of value (Smith, 1989); a logic of worth (Stark, 2009); and a sociotechnical *agencement* (MacKenzie, 2009). The market is everything and nothing; local and global; rational and emotional.

For students of the economy, the claim that markets are multifaceted is hardly revolutionary (e.g. Lie, 1997). Confronting the timeless and asocial characterizations of neoclassical economic theory (Fligstein, 1996), recent literature has brought to the fore the shifting nature of the market, showing its historical specificity (Mirowski, 1988), underlying sociality (Granovetter, 1985; Podolny, 1993; White, 2002), cognitive fabric (Beunza & Stark, 2004; Knorr-Cetina & Preda, 2001), and overt materiality (Pinch et al., 2008). Even within economics, there is today an increasing recognition of the diversity of market forms and the importance of structural elements in economic behaviour (e.g. O'Hara, 1997). Markets are now designed. And calculation is the purview of computer algorithms as much as it is of rational agents.

The market, thence, is more chimera than chameleon, an animal formed by many animals, a material, embodied, ideological and symbolic mixture.

This chapter seeks to contribute to the theoretical mélange of the sociology of markets by dealing with the forms of knowledge, practice, embodied action, and symbolic labour that lead to the constitution of a particular market form, finance. In particular, this chapter explores not what financial markets *do* but how they are *made*. This exploration is carried out in two parts. The first, captured, in section 1, introduces the theoretical instruments used to understand the mechanisms behind the creation of markets. Referred to as 'market-making regimes', these mechanisms constitute a taxonomy of the types of social actions deployed when creating specific manifestations of the market. In the second part of this chapter, I analyse the role of metaphors in market-making regimes. Section 2 presents a theoretical examination of the use of metaphors in market-making practices, focusing on the socio-cognitive and coordinative roles of metaphorical structures. This section also introduces a specific metaphor – the so-called informatic metaphor – as an example relevant to the history and sociology of modern finance. In seeking to understand its role in the making of markets, section 3 presents a brief genealogy of the informatic metaphor. Finally, section 4 provides a broad (perhaps tentative) sketch of the manner in which the informatic metaphor was deployed in American and British financial markets.

7.1 The Constitution of the Market

Let me start with the simple statement that the market is more than exchange. This recognition, which implies that the scope of the market overflows the transfer of goods and services between producers and consumers, is perhaps the single most important contribution of the recent sociological and anthropological literature on economic life. The market, in this sense, involves not only relationships of exchange – which may or may not be anonymous, and which may or may not be monetary – but also entails creating symbolic, material, and cognitive supports that enable economic life-forms to emerge.

The market, then, is not reducible to the bounded and objectivised account of the economy as posed by our modern social imaginary (Taylor, 2004). Market interaction is embedded, whether in pre-existing social relations (Granovetter, 1985), inter-firm networks of producers (White, 2002), or politico-cultural relations between organisations (Fligstein, 2001). The market, however, is not merely the enactment of socialised forms of calculation in relation to a specific problem of exchange. The market is formed neither by collections of socialised *Homo oeconomicus* nor by a set of mechanised *Homo sociologicus*. Effectively, the market exists beyond a single evaluative framework, dependent on several competing logics of justification (Boltanski & Thevenot, 2006).

The market is thus formed at the interface of several forms, fields, discourses and practices. While the market is embedded in broader forms of marketing – just as the economy is embedded in economics (Callon, 1998) –, it is also rooted, for instance, in the discourse and instrumentalia of civic and political rationality (e.g. the law, governance and public policy). Although produced through specific forms of economic knowing and particular modes of economisation (Caliskan & Callon, 2009), as a social institution, the market incorporates several – possibly incommensurable – conventionalities of value, contest and coordination.

As Koray Caliskan noted in his study of the global market for cotton, the market is an 'elusive thing' (Caliskan, 2005). The hybrid elusiveness and pervasiveness of the market may indeed stem from the multiple roles it performs in society and the myriad types of labour that factor into its creation. Any attempt at definition, any attempt at fixing the fluidity of this chimerical cultural entity, would be thus futile.

The futility of demarcation is not an impediment to analysis, however. Rather than trying to describe the market as a concrete object whose operation is driven by specified rules, sociological analysis can shift to the mechanisms through which social actors create, deploy and defend boundary objects (Leigh Star & Griesemer, 1989) and boundary organizations (Guston, 2001) around the common theme of 'the

market'. Thus, instead of attempting to access the market as empirical reality, the analysis of economic life can concentrate on the specific forms of work that take place in the putative constitution of a market.

Here, I will refer to the forms of work that go into the creation of a market as regimes of market-making. By a regime of market-making, I mean the localised set of social actions that respond to the question: How is a market made? As recent discussions suggest – in particular, those at the confluence of science and technology studies and economic sociology – acts of market-making take a multiplicity of forms. To analyse the ways in which markets are constituted, this multiplicity is categorised into six distinct regimes: the material, embodied, affective, social, cognitive and symbolic.

This focus on forms of market-making is meant to highlight two aspects of the market. First, the shifting manners in which social actors relate to this entity as an apparently abstract mechanism whereby supply and demand confront each other and adjust (Callon, 1998). Through concrete work, I argue, the allegedly abstract market is given actual manifestations. The market, in this sense, is constituted beyond the dichotomy between theoretical and practical activity, between economics and the economy. The market, for instance, is place: one can be 'in the market' or 'out of the market'. The market is also material and movement: the market goes 'up' and 'down', is 'hot' and 'cold', 'soft' and 'hard'. Furthermore, the market is artefact: it can 'work' or be 'broken'. And it is also emotive and cognitive: at times, the market gets 'angry' with speculators, becomes 'crazy' or is, conversely, 'kind' and 'mellow'. Like the market, the forms of market-making work across various domains, creating a common interface to which all align their social actions.

Second, the identification of regimes of market-making responds to the observation that there is no unique way of constituting a market. Market-making means different things in different social and historical contexts. For a jobber on the floor of the London Stock Exchange circa 1950, making a market meant creating the possibility of exchange by uttering a quote, assuring the conditions of felicity

(Austin, 1975) upon which a conversational exchange could become performative (Pardo-Guerra, 2010). For that actor in that space, making a market was concomitant to creating the possibility, rather than assuring the certainty, of exchange: the market was not in exchange but in the possibility thereof.

7.1.1 The material regime

Uttering quotes on a trading floor is not the only way one can make a market. The most straightforward type of market-making involves the use and modification of the material world with the aim of creating supports for calculation and exchange. Marie-France Garcia-Parpet's now classical study of the construction of the strawberry auction market in Fontaines-en-Solonge (Garcia-Parpet, 2007) provides a clear illustration of this, the material regime of market-making. To achieve the practical realization of the pure model of competition, argues Garcia-Parpet, the auction venue was construed to differentiate between buyers, sellers and the auctioneer. The market was 'made', in a very material sense.

Like the jobber on the floor of the Stock Exchange, a programmer working on an electronic communication network is also making a market, creating the platform on which exchange may be possible. So is the architect, designing the floor plans for a new trading room, or the computer engineer, installing faster connections between servers to minimize latency. Although their activities might seem intrinsically technological, they are also overtly oriented toward the making of a market.

The fact that markets are material – or have concrete material manifestations – now seems a commonplace, as demonstrated by the growing literature in the social studies of finance (MacKenzie, 2009; Pinch et al., 2008). The recognition that material labour goes into the creation of market nevertheless continues to be a source of valuable insights into the dynamics and evolution of economic life. As chapters 3 and 4 showed, the history of the Stock Exchange was inextricable from the history of the market's materialities. Due to its concrete materialisations, the market provided by the Stock Exchange was prone to the sticky dynamics of the physical world. For the Stock Exchange, the adoption of technologies entailed new types of work—for

instance, routine maintenance. In providing market information services, the Stock Exchange hired computer and telecommunication engineers that guaranteed the reliable operation of its systems (perhaps recognizing that the implementation and use of technologies requires local, tacit forms of knowledge Fleck, 2003). And as demand for the systems grew, and with it the pressure for increased reliability, the number of technologists climbed. Decisions to update systems only accelerated the process, leading the Stock Exchange to increase the size of the Technical Services department and expand the expertise of the organization, hiring analysts, programmers, managers, developers and support staff. The work associated to the market information services – the material regime of market-making – transformed the Stock Exchange into a centre of technological innovation and the market into an explicitly technological entity.

7.1.2 The embodied regime

Markets, however, are not only made by materialities and their associated forms of labour. The market is also constituted through particular forms of embodied action (e.g. Abolafia, 1996; MacKenzie, 2006). Whether in the apparently ruthless trading pits of Chicago (Zaloom, 2006) or the civilised environment of an auction room (Heath & Luff, 2007), making a market, entering into a contract, participating of exchange, entails specific conventionalities on the use and articulation of the body.

The introduction of radio-communication technologies into the floor of the Stock Exchange provides here a relevant example of the bodily constitution of markets. When these technologies were adopted by member firms to facilitate the communication between brokers on the floor and their offices, they inadvertently revealed some of the types of embodied labour that went into forging contracts. Through the use of portable bidirectional radio devices, in particular, brokers could request instructions and information from their offices without leaving the floor. For jobbers, the use of such systems entailed new informatic asymmetries that were impossible to minimise with their knowledge of the floor. As David Steen, recalled in interview, the introduction of these devices

> was a frightful sort of hoo-ha […]. You weren't allowed to use your walkie-talkie set actually on the jobbers pitch, so the jobber was standing here [with

> his price board next to him] and the broker came up [and] would ask for a price. Then he'd go off [there], [a couple of meters] over here, and he'd report to his office. Now, the jobber could change the price while [the broker was on the walkie-talkie with his office]. But he wasn't allowed to do it while he was standing on the pitch. You wouldn't have got much good will with the broker if you did, but there circumstances were it had occurred. (Steen interview).

The agreement to buy or sell shares was formed not only on the back of conventions on dealing as a conversational exchange (Pardo-Guerra, 2010) but, importantly, through specific embodied performances from those on the floor of the Stock Exchange.

7.1.3 The affective regime

The embodied dimension of market-making has the corollary of rendering the market into an affective object. In their interactions, social actors involved in the making of markets adopt emotional languages to describe their routine activities and the constitutive relations they establish with the market-at-large. As several authors have argued elsewhere, market processes are bound to emotions. As recent scholarship suggests, emotions seem to perform several roles in the stabilisation of the market, operating as either heuristics for rational action, contributors to the creation of trust (Banelj, 2009), or as factors that contribute to the shaping of expectations (Pixley, 2002).

An example of the prevalence of affectivity as a market-making practice is provided in the work of Karin Knorr-Cetina and Urs Bruegger. In their study of the postsocial relationships constructed between traders and their screens, (Knorr-Cetina & Bruegger, 2002) identified, amongst other things, emotional vocabularies through which the (mainly electronic) market is represented. Traders, they note, say they 'feel' and 'sense' the market. And although reference to a 'feeling' might seem, more than anything else, an expression of tacit forms of knowledge developed around the interpretation of market information, this ambiguity is also associated to the affective modes with which individuals relate to, and the affective characteristics they ascribe to, the market. The market, for instance, is often represented as a sexualised entity, 'shafting', 'bending over', 'blowing up', 'raping' and 'hammering' those who dare challenge it (Knorr-Cetina & Bruegger, 2000; Zaloom, 2006).

These and similar affective tropes are often complemented by stories of game and theatrical performance. In his recollections of the City of London, Michael Verey (1912 - 2000), a former banker with Helbert, Wagg, noted that business was 'a means to an end. We wanted to have fun and crack some jokes' (quoted in Courtney et al., 1996, p. 9). For brokers and jobbers, dealers and investors, the market was play, a bounded space for ludic interaction. Recalling his days on the floor, David Steen stressed the 'enormous fun' he had as a jobber (Steen interview). And as broker for Philips & Drew, Paul Bazalgette warned those tempted to feed their business into a computer, 'dealing done that way will never be fun. Dealing certainly ought to be, and I think that between humans it usually is' (Kynaston, 2002, p. 422).

7.1.4 The social regime

The view that markets are the ultimate product of social action is a long and illustrious claim (e.g. (Weber, 2000) [1924]). Indeed, a considerable part of the theoretical and empirical efforts of economic sociology over the past thirty years have gone into demonstrating either that socio-politico institutions are necessary for the existence of an economy or the manner in which the market is embedded in a larger social domain. While some authors sought to explicate economic life in terms of culture-bound scripts that frame economic action (Zukin et al., 1990), others identified the calculative agency in social networks that allow actors to reduce uncertainty and engage in exchange (Granovetter, 1985; Callon, 1998).

These approaches, however, tend to focus on the fabric of calculative agencies, that is, on the sociology of the calculative devices (Muniesa et al., 2005) that bring market interaction into being. The other forms of social labour that go into the creation of a market are thus rendered peripheral to the analytical gaze. These types include manifestations of social action that are not explicitly calculative but that, nevertheless, constitute varieties of market-making insofar as they create boundaries and structures between the market and its putative exterior. A clear example is provided by forms of interaction oriented at creating trust between parties around the act of exchange, that is, types of social action oriented at providing cohesiveness to the social networks of the market.

Entertaining a client, attending a trade conference, visiting a company director, holding a conversation with an investor, or engaging in a long lunch with colleagues all contribute to making the market. These acts, in a sense, provide members of the community of market practitioners forms of knowledge that, due to their interpersonal qualities and located nature, can be difficult to obtain by other means. As the previous chapter argued, the regulatory control of the London Stock Exchange's market – which is tantamount to defining the limits of the market as sphere of legitimate action – was closely associated to the interpersonal forms of knowledge developed brokers and jobbers. For this, structures, and almost ritualistic, activities such as the legendary 'long lunches' of the City of London allowed people 'to know each other better, and to understand each other. I think that actually helped the flow of business' (Steen interview). In the words of George Nissen, former broker with Pember & Boyle, the lunch-room in his firm was

> an immensely important part of the business and got to know our clients extremely well inviting them to lunch […] [The Stock Exchange itself was] a sort of lunch club […] It all adds to your understanding of what people you're working with and your general information about what's going on in the City (quoted in Courtney et al., 1996, p. 197-198).

Arguably, part of the work performed by the cultural circuits of capital (Thrift, 2005) is precisely to create and circulate specific forms of interpersonal and systemic knowledge that can only be accessed through social interactions within the market's communities. To keep the market alive beyond the relationship of exchange requires, in a sense, the incessant activity of forging, modifying and qualifying social connectivities.

7.1.5 The symbolic regime

The social investments in market-making are frequently – though not necessarily – related to the creation of readily transportable signposts. The representation of the Stock Exchange as a national institution, for instance, involved creating a particular imaginary of honour and respectability, which achieved expressions in the concept of gentlemanly capitalism as well as in the regulatory attitudes towards finance in Britain. Effectively, the market is populated by symbols that allow actors to orient their behaviours towards a common strategy. Symbols and symbolic structures

enable, for example, the formation of coalitions, articulating critique, and exploring futuristic possibilities. As a case in point, the imagery of the market as a mechanism driven by the invisible hand of collective rational action has long been a rhetoric instrument for political mobilisation. As signposts, symbols provide the possibility of defining the 'inside' and 'outside' of the market, allowing for social actors to refer to the internal constitution of the marketplace and its outward projection. In effect, the diffuse edges of the market are supported by second order symbolic systems, by sets of mythologies (Barthes, 1993) that are the discursive resources upon which boundary work is performed.

Symbolic work, however, also takes local and precise forms. The prices on an electronic trading screen, the FTSE index, the Dow Jones Industrial Average and the London InterBank Offered Rate all required efforts to become entities that are widely acknowledged to trigger market action. To feed into calculative agencies, furthermore, these symbols have to be made conventional: they need to acquire meaning within a particular community. Prices, for instance, do not emerge 'naturally' out of market interaction. Rather, they are carefully produced in relation to the conventionalities of meaning and practice of investors and intermediaries (Muniesa, 2007; Pardo-Guerra, 2010).

7.1.6 The cognitive regime

Finally, making markets is also a cognitive process. Here, well-known analyses of the processes of classification, standardisation, commensuration, accounting, economisation, qualification and calculation that lead to exchange provide plentiful examples (see (Caliskan et al., 2009; MacKenzie, 2009; Stark, 2009; Podolny, 1993; Callon, 1998; Carruthers et al., 1999)). Yet as these studies demonstrate, the cognitive work behind market-making is not reducible to internalised machine-like mental calculations. On the contrary, the cognitive efforts that make market exchange possible are distributed. They are, in a sense, coextensive to assemblages of human and non-human entities (MacKenzie et al., 2007). Hence, the models and theories utilised to conceptualise the market as an identifiable object – e.g. financial economics – are as much an element of cognition as the act of processing a stimuli

and producing a response – e.g. deciding how to react to a change of price on a trading screen.

7.2 Market and Metaphor

As an analytical tool, the regimes of market-making presented above should not be confused with closed domains of action defined in terms of the organisation of embodied or epistemic labour in the marketplace. Similarly, they should not be deemed an injective mapping from a set of logics of worth (Boltanski et al., 2006; Stark, 2009) onto a set of concrete forms of social action. The market-making activities of particular actors can exist simultaneously in several regimes. Consequently, specific manifestations of market-making – for instance, creating a limit order book, or designing the display of data on a trading screen – involve performing work across two or more regimes. Thus, the material regime is not limited to the technologist who builds an automated execution system. As well as making a market in a physical sense, the technologist also engages in symbolic work (defining, for instance, forms of market visualisation), and a reasonable degree of social work (she has to sell the product to her company and the users, creating networks of producers, developers, and consumers). A trader, similarly, is not constrained to cognitive work. A trader does not merely construct the market as a cognitive entity but, on the contrary, renders the market into an affective object, becomes a weaver of social connectivities around the relationships of exchange, and lives the market as an embodied experience.

Making markets is therefore an activity that can take numerous forms. But precisely due to this multiplicity, precisely due to the fact that it is made across several regimes, in different locations, and at varying times, the market cannot be apprehended in its entirety. The market is concrete and abstract, contained and ubiquitous, here and everywhere. We experience the market for cotton by walking into a clothing store, observing prices and products, and choosing to buy a particular t-shirt. But we also experience the market in other tangible ways, for instance, by growing, transporting, or trading the cotton and its derivatives. The market, nevertheless, is not reducible to any of its specific manifestations: the market is an

abstract conceptualisation, a larger assemblage of institutions, boundaries, individuals, things, techniques, models, languages, images and feelings (Caliskan, 2005). We can relate to equations, models and theories; we can relate to political ideologies and machinations of perfect societies; we can relate to calculative practices and specific systems of worth; we can relate to specific suppliers and providers, but we cannot relate to the market as a whole.

The impossibility of wholesale access to the market explains the use and prominence of higher order representations as the basis for collective coordination (Knorr Cetina & Preda, 2001). As a policy instrument, the theoretical instumentalia of economics offers a particular mode of concrete apprehension that provides some types of market-makers (e.g. an International Monetary Fund analyst or a government minister) a common set of referents: in all its complexity, the market is reduced to equations and numbers, to tractable relations between discrete entities. A graph, too, serves as concrete mode of apprehension, representing 'the market' as a bounded visual unit: supply and demand, producers and consumers are transformed into two lines on a bi-dimensional plane. In the London Stock Exchange, the trigger screen introduced by Michael Newman on SEAQ provides yet another example, allowing traders to leave the floor and move onto the dealing desk by 'capturing' the market through colour and movement (chapter 4). Finally, market prices – like the practice of marking a price – are also construed as concrete manifestations of a larger system, as readily transportable entities that allow social actors to refer to 'the market' in a specific thing, be it cotton, company shares, or index derivatives.

The unfeasibility of total apprehension also explains the pervasiveness of metaphorical vocabularies as means for describing the market. For the cognitive linguist George Lakoff, metaphors are the main mechanisms through which we comprehend abstract concepts and perform abstract reasoning (Lakoff, 1992). Whilst we cannot capture the market in its entirety, we can apprehend metaphors of its nature and operation. Thus, the metaphor of markets as vertical movement (e.g. 'prices went up' or 'the market went down') has concrete manifestations in setting up

the repertoire we use to represent the market. The market slides, slumps, falls and tumbles, and it rises, bounces and breaks the ceiling.

Yet metaphors are not merely figurative. On the contrary, metaphors are conceptual, embodied elements of cognition that result from our concrete experience with the physical world (Lakoff et al., 2003). The metaphor that 'more is up', argues (Lakoff, 1992), is grounded in the common experiences of everyday life: pouring fluid into a container and seeing the level go up, or adding more things to a pile and seeing it get higher. In these experiences, we develop a correspondence between different conceptual domains. In the case of 'more is up', we establish a correspondence between the domain of quantity and that of verticality: 'more' becomes 'up' whilst 'less' becomes 'down'. In most metaphors, however, the correspondence in real experience is unnecessary: a metaphor is often intelligible because it has a regular correspondence with many other cases, some of which are bound to experiential grounds. We need not be told, for instance, that a market 'bounce' is 'more' whilst a market 'slide' is 'less'.

Metaphors, then, create systematic mappings between domains, for instance, between verticality and quantity, between emotions and colour. And precisely due to their incidence across domains, metaphors are instruments that intervene in our relation with the world-at-large. Like models in science (Morgan & Morrison, 1999), metaphors mediate our every-day interactions, creating conceptual linkages and structuring our actions around a common experiential relation: metaphors of market as movement, market as substance, market as colour, and market as animal become coordinated and, more importantly, serve as a common mechanism for organising and orienting behaviour. Metaphors go to the very core of our interaction with 'the market', shaping our expectations as to what the future has in store. In their insightful study, (Morris, Sheldon, Ames, & Young, 2007) show that the use of agentic metaphorical commentary (e.g. 'the NASDAQ climbed higher') prompted the audience to expect the continuation of trends, whereas the use of object metaphors (e.g. 'the NASDAQ was pushed higher') did not. In this instance, via specific

metaphors, certain expectations on the nature and future of the market were created, possibly shaping the decisions taken by the audience.

But metaphors are not constrained to the domain of individual cognition. Metaphors, rather, are elements of the coordinative repertoires of social actors. As Barry Barnes as John Dupre note,

> without the models and metaphors current in our shared everyday culture, social coordination quite generally would not be possible, and social life in the sense that human beings know it could not exist. The deployment of models and metaphors relevant to our present concern is just the redescription of things and goings-on in one context in terms of familiar shared patterns established in other contexts. If blinkered vision is sometimes encouraged by shared models and metaphors, it is the price that has to be paid for the coordination they allow (Barnes & Dupre, 2008, p. 61)[1].

Metaphors are mechanisms for coordinating action by means of the conventionalities of experience as much as they are devices for apprehending environmental surprises by making situational knowledge about novelty transportable.

How, then, can we account for changes in our relation with, and understanding of, financial markets? The observation that our concrete market-making practices hinge on broader systems of metaphor offers a possible answer: the historical evolution of financial markets can be narrated as much in terms of shifting institutions, materialities and practices as through the changing metaphors used by market-makers in creating, bounding and reformatting economic life. The history of the market is, in a sense, mirrored by the history of the metaphors used to describe it.

Economics provides a useful example of the role of metaphors in our market-making practices. For the sake of argument, let us consider economics a form of cognitive market-making. In the end, economics is an intellectual tool that attempts to represent economic exchange through a concrete set of practices (e.g. mathematical abstraction, the creation of models and theories, the use of statistical techniques) and that, increasingly, seeks to be a source of insight for economic (and non-economic) policies. In a sense, let us follow the logic of Michel Callon's

[1] I owe this point to Donald MacKenzie.

performativity programme (Callon, 1998), accepting economics as an agent that bears upon the configuration of the economy. If we allow for this possibility, if we embrace economics as a form of market making, then much of the literature on the history of economic thought is rendered a history of metaphors. The work of Philip Mirowski is salient in this respect, tracing the sinuous path of economics, from the natural metaphors entangled with the language of biology, evolution and physiology (Mirowski, 1988), to the mechanical metaphors of physics (Mirowski, 1999b), to the cybernetic dreams of the twentieth-century (Mirowski, 2002). Economics is a domain rife with metaphorical language (McCloskey, 1995). Metaphors here are not merely allegorical or pedagogic (Klamer & Leonard, 1994); they are, in all ways, structural to discourse (McCloskey, 1983).

However, economics is just one form of market making. My point here is rather more general. Here, I posit that the use of metaphors is endemic to virtually all regimes of market-making as it is to all of our linguistic and concept-making practices. It is no coincidence, for instance, that the vocabulary of economic life on the floor of the London Stock Exchange was once governed by metaphors of 'market as space', 'market as physical effort' and 'market as animal'. As former broker Dundas Hamilton explained in his account of the practices of the Stock Exchange (Hamilton, 1968), brokers on the floor had 'positions' that were 'carried over' accounting periods; prices were either 'above' or 'below the market'; shares 'floated'; investors were 'long' and 'short'; brokers could do 'put-throughs' by matching shares without recurring to a jobber; the market had a 'touch'; profits were 'turns'; and some valiant brokers were 'stags'. The market, then, was constituted at the interface of concrete instances of work, social connectivity, and the experiential metaphors of embodied space and time. It is indeed not surprising that for much of the twentieth century the dominant metaphor of the market, the regnant interpretation of finance, was that of the 'club'. The club was not a descriptor of reality, as much as it was a metaphor of the sociality of exchange. After all, finance was a matter of embodied action and social connectivity: trade was conducted on the floor of the Stock Exchange, requiring physical presence and distinct conversational conventions (see chapter 3), and identities were bound to the social imaginaries of gentlemanly

capitalism (as discussed in chapter 5). Associated to the imagery of the gentlemanly capitalist, the metaphor of the club was not merely a linguistic affordance, however: critically, it allowed actors to establish limits, create boundaries, negotiate access and rally authority and legitimacy. This metaphor, certainly, was critical to the day-to-day operation of British of finance.

But experience is also technologically mediated, and arguably one of the most important metaphors of contemporary market-making practices bears the sign of the machine. The metaphor in question, referred to by some as the informatic metaphor, presents the world as reducible to the mining, distribution, coding, and decoding of information. The world, for this metaphor, is an information processor. And in its associated ontology, all there is at the end of the day is information and its flows.

7.3 Informatic archaeologies

In 1970, Eugene Fama published what is perhaps one of the most significant articles of late twentieth century economics (Han Kim, Morse, & Zingales, 2006). Reviewing the extant literature on the behaviour of stock prices, Fama approached theory and evidence by introducing a novel yet subtle conceptualisation of the market. For Fama, the reigning debate on the randomness of stock prices could do with some reorganisation. Specifically, economic analysis should focus on determining whether markets were or not 'efficient', that is, whether securities prices at any given time 'fully reflect' all available information (Fama, 1970).

Within the history of economics, Fama's article marked the début of the efficient market hypothesis, the consolidation of a dominant theoretical canon on the structure and behaviour of financial markets (Jovanovic, 2008). Predicated upon established traditions of economic thought (Samuelson, 1964), the efficient market hypothesis was, and continues to be, an object of intense empirical inquiry (for early debates, see Jensen, 1978; Shiller, 1981; Summers, 1986). The significance of Fama's hypothesis, however, extended beyond technical debates. Importantly, the

criticality of the efficient market hypothesis resided in its metaphorical scaffold, in the fact that it represented financial markets in informatic terms.

The informatic metaphor used by Fama – and that became commonplace in the modern vocabulary on finance – formed part of a broader discursive movement. From the Second World War onwards, emphases on informatic issues and their associated metaphors spread across the disciplinary landscapes of Europe and North America. The work of Fama and his peers manifested such expansion within financial economics. In the larger realm of the economics profession, the transformation of information into a variable was, in the words of Kenneth Arrow, 'the greatest development of the century' (Arrow, 2001, p. 300). Yet the use of information as a representational instrument was rife elsewhere: in accounting, information provided an objectivised veneer to the analysis of corporate statements (e.g. Lee et al., 1969; Beaver, 1968; Butterworth, 1972); in management, information was the basis for a general approach to the regulation of organisations (e.g. Boulding, 1956); in psychology, information allowed rendering the mind into a manageable machine (Attneave, 1959; Edwards, 1996); in biology, informatic metaphors were central to the development of the control and communication models of genomics and molecular biology (Barnes et al., 2008; Fox-Keller, 2002; Kay, 1995); and, via statistical thermodynamics, information emerged as a standard concept in the analysis of astrophysical phenomena (e.g. Bekenstein, 1973; Bekenstein, 1975; Hawking, 2005).

The history of the informatic metaphor has been gleaned by several well-cited studies. Notably, the works of Philip Mirowski (2002), and Lily E. Kay (1995) and Evelyn Fox-Keller (2002) highlight the careers of the informatic metaphor in economics and biology respectively. Similarly, in *The Closed World*, Paul Edwards (1996) provides a thorough and insightful account of the genesis of computing metaphors within the military circles of the Second World War and their subsequent mobilisation within the societal discourses of Cold War America.

The work of these authors highlights three processes that were constitutive of the informatic metaphor. The first was the consolidation of 'formal' approaches to puzzles in computing, communications and strategy. These included the formalisation of computing theory (e.g. Turing, 1936), the emergence of information theory (e.g. Shannon, 1937; Shannon, 1948), and the development of game theory (e.g. von Neumann & Morgenstern, 1944). Founded on definitions of information as a statistical function over a finite set of signs, these approaches transformed some of the technological problems confronted by Anglo-American military forces during the Second World War (including issues of encryption, securing communication channels and optimising field tactics) into a manageable body of abstract mathematical relations. As a common denominator to these puzzles, information provided a conceptual foundation upon which authors could construct a theoretical idealisation for apprehending the increasingly electronic environment of the twentieth century.

Associated to these theoretical developments, the informatic metaphor was strengthened by the work performed in cybernetics. As Norbert Weiner, one of the founders of the field wrote, cybernetics offered a 'unified' approach to a set of problems in 'communication, control, and statistical mechanics, whether in the machine of the living tissue' (Weiner, 1948, p. 11). Through the collusion of biological and mechanical metaphors, cybernetics acquired the guise of a 'grand theory of information and control' (Edwards, 1996, p. 1), eroding a long-standing ontological divide between 'humans and machines, the living and the dead, the active and the inert, meaning and symbol, intention and teleology' (Mirowski, 2002, p. 13). Such ontic reconfiguration proved fruitful: through a cybernetic transformation, researchers tackled issues as diverse (and militarily relevant) as human-machine interaction, learning, cognition and organisational design. Here, the optimisation of anti-aircraft gun control served as an exemplar (Galison, 1994; Hacking, 1998; Edwards, 1996; Mirowski, 2002). The accuracy and efficiency of the mechanism could only be improved, argued cyberneticians, by understanding the human operator and the machine as a single unit forming a 'self-steering device guided by an information feedback loop' (Bousquet, 2009, p. 108). The operator's mind was thus

another computer in the loop, and systemic regulation was produced by processing the information received from the environment and reacting accordingly.

The birth of operations research was the third contributor to the expansion of the informatic metaphor. Similar in form to cybernetics, operations research emerged during the Second World War as a result of the involvement of scientists (primarily physicists and statisticians) in the Anglo-American military efforts (Fortun & Schweber, 1993). Partly inspired by the theoretical approach of information theory and optimisation techniques (see Ackoff, 1956; Krulee, 1954), operations research was generally concerned with the application of statistics to predicting and comparing the costs of alternative courses of action involving human-machine systems (Mirowski, 1999a). As such, operations research offered a formal approach to problems of organisational decision-making, a fact that was exploited by the community of operational researchers when they built the professional boundaries of the field at the end of the war. Indeed, operations research survived the war successfully by becoming a practical instrument for improving 'the everyday operation of administrative organisations' (Simon & Newell, 1958). With the ensuing diffusion of operations research in civilian circles (Kirby, 2000), the metaphor of organisations as informatic entities reached the halls of industry and government.

Weaved in the organisational and technological looms of the war, the informatic metaphor was thus created. From an early stage, information ceased to be a technical shorthand for an abstract relation between signs (Shannon, 1948), becoming a wholesale physical concept. Like mass, energy, time and space before, information acquired ontologically stable qualities (Mirowski, 2002). Importantly, information was understood through the so-called conduit metaphor. First articulated by Michael Reddy (1979), the conduit metaphor presents ideas as stable entities that travel through a channel between senders and receivers, mirroring the basic communications model of information theory (Day, 2000). According to Reddy, in our language about language, speakers convert ideas into objects, put objects into words, and send words along conduits to hearers who take the ideas/objects out of

their words/containers (Lakoff et al., 2003). The conduit metaphor hence renders information into a thing that can be 'obtained', 'accessed', 'diffused', 'channelled', 'extracted', 'flowing', 'spilling' and 'travelling' through our technologies of communication (Boal & Lakoff, 1995). Through technology and discourse we became, *pace* Hacking, realists about information as an entity (Hacking, 1983).

7.4 Making markets informatic in America and Britain

7.4.1 America

In finance, the metaphorical affordances of information and communication technologies became particularly relevant to market-making practices in 1960s and 1970s America. Notably, the ascent of the informatic metaphor as a central mediator between economic actors and the market was exemplified in numerous episodes of the financial history of the United States, where in a matter of years markets became widely conceptualised in terms of technologically supported information flows.

Arguably, the ultimate success of the informatic metaphor in America responded to a peculiar collusion between geography and politics: from a historical perspective, the American financial system had grown in a fragmented manner, with different trading venues competing to capture a larger share of the market. Although prominent, the New York Stock Exchange by no means monopolised the national market, sharing space with regional exchanges – from San Francisco and Philadelphia to Chicago and Boston – and national venues – including the American Stock Exchange, the National Association of Securities Dealers, and the all-electronic Instinet.

Decisively, however, the American market was united by the centralising agency of the Securities and Exchange Commission which since the 1930s had overseen financial regulation in the United States. Through its political clout, the SEC proved fundamental in catalysing the automation of American finance. Authorised by Congress in 1961, the SEC created a special group responsible for studying and investigating the 'adequacy, for the protection of investors, of the rules of national securities exchanges and national securities associations' (House Commerce

Committee, 1961). Published in 1963, the Report of the Special Study group stressed the advantages of automation and electronic quote dissemination in 'vastly increasing the flow of market information and […] insuring better executions for the public' (Securities and Exchange Commission, 1963, p. 657). Surveying the future, the Special Study prepared the grounds for digital finance. From their consultation with specialists in electronic technologies – including the Univac Division of Sperry Rand Corp –, the Special Study group noted

> the potentiality of a system which would select the best bids and offers, execute orders, and clear transactions. Transmitting and receiving units would be installed in the offices of all subscribing broker-dealers. Wholesale dealers and other broker-dealer subscribers could enter quotations (and size of market) into a central computer for indexing under the appropriate security and could interrogate the computer to determine the highest bid and lowest offer, selected by the computer, together with the number of shares bid and offered at such prices (Securities and Exchange Commission, 1963, p. 657).

The fragmented marketplace, the 'lack of central location', could thus be 'overcome by the use of a single, central computer' from which information about trading would flow to both the professional dealer and the public.

Soon enough, information technologies became recognisable instruments of regulation. By the mid 1970s, the US Congress and the SEC sought to extend regulatory control over the securities industry through the transformation of the material infrastructures of American finance. Amendments to the Securities Exchange Act in 1975, in particular, mandated the development of a National Market System (NMS), giving oversight and control over its establishment to the SEC. The objectives of the NMS resounded both with the ideals of economic theory and the regulatory imperatives of the SEC. The novel arrangement was to enhance the economic efficiency of transactions, ensure fair competition, provide broad availability of information, and – subjected to best execution policies – guarantee the possibility of automating trades. Towards the end of the 1970s, a suite of technological systems gave shape to the NMS: while the Consolidated Tape unified the reporting of trades, the Consolidated Quotation System created streams of market information from the trading venues to the computers of data vendors.

In a substantial way, the fifteen years between the publication of the Report of the Special Study group in 1963 and the introduction of the Consolidated Quotation System in 1978 marked a profound change of the experiential character of finance in America. Markets were increasingly mediated by digital technologies and, following a tradition possibly inaugurated by the ticker tape (Preda, 2008), 'information flows' became the blood of the marketplace. Concretely, the diffusion of information and communication technologies allowed cyborg metaphors to enter finance at the level of the embodied and material regimes of market-making: both the experience of being 'in' the market and the construction of novel market platforms, supports and architectures was mediated by the metaphor of economic and organisational life as informatic performance.

Changes in the modes of apprehending and representing markets were also experienced elsewhere. For economists and business scholars of the 1960s, in particular, cybernetic metaphors allowed re-inventing their professions around novel conceptualisations of knowledge, calculation and economic exchange. Interaction and coordination could now be modelled as a chain of information processors, a communication channel between companies and investors, between the world and the market. The economy, like society at large, became a subject of communication, command, control and intelligence – C^3I, the paradigmatic pillar of cybernetic warfare (Mirowski, 2002). Financial economists took the metaphor to the extreme. Eugene Fama, for instance, presented decision-making in the market as amenable to information theory, referring his readers to Fred Attneave's *Applications of Information Theory to Psychology* (Attneave, 1959). In effect, later conceptualisations of efficiency as based on the market's processing of financial information (e.g. Fama, 1970) were rooted on the earlier application of information theory to the behaviour of stock prices (Fama, 1965; Theil et al., 1965). For Fischer Black, a forbearer of modern portfolio theory, finance could similarly be computational. A stock exchange, he wrote,

> can be embodied in a network of computers, and the costs of trading can be sharply reduced, without introducing any additional instability in stock prices, and without being unfair either to small investors or to investors at large (Black, 1971, p. 87).

And as the Consolidated Tape entered in operation in 1974, economists Kenneth Garbade and William Silber provided empirical support to the connections between technology and the quality of markets. In their study of the telegraph, telephone and electronic tape in American and British markets, Garbade and Silber (1978) observed enhanced integration, reduced information delays, and a significant narrowing of inter-market price differences after technological adoption. For financial economists and regulators alike, technology was a handmaiden of the market, the visible skeleton of a global, invisible hand.

7.4.2 Britain

Informatic metaphors, however, were by no means as mobile and transportable as the physical circuitry of the computer. The cyborg vocabulary that emerged in America was the result of the intense and localised efforts of scientists, economists, technologists, government officials and military organisations. Cyborgs, in sum, were the offspring of the American institutions of the Cold War (Edwards, 1996; Mirowski, 2002). Big science, nuclear warfare, global telecommunications networks, theories of human-machine interaction, and deconstructions of management-as-information control all gave cyborg metaphors their seemingly universal credence. Yet the metaphors of the cyborgs were bounded to ideology and experience, contained by the limits of a closed-world discourse. And as an instance of the cyborg worldview, the informatic metaphor was also constrained, originally to the domain of military engineering, subsequently to the managerial language and technological practices of post-war America.

In Britain, the informatic metaphor followed an altogether different route. Unlike the United States, British cybernetic vocabularies seemed to fade away soon after the Second World War, only to be rediscovered in the so-called information age. In the United Kingdom, metaphors derived from computers, automation, and the manipulation of information were limited both in practical scope and political possibilities. Despite having been home to numerous proto-cyborgs – including Alan Turing, the computer scientist, Patrick Blackett, the physicist, and Maurice Kendall, the statistician – the obvious proponents of a cybernetic worldview in Britain seemed not to have fared particularly well to the messy politics of the post-war. Notably,

during the crucial period between the 1940s and 1960, British operations research – one of the platforms for the expansion of cyborg metaphors in America (Mirowski, 2002) – was largely sidelined. For the British military, operations research was a tactical matter rather than an issue of the higher strategic conduct of war; and as of its founders, they were either denounced as academic imperialists that attempted to usurp the roles of civil servants or labelled communist sympathisers (Kirby, 2000). In his history of the field, Maurice Kirby notes that the diffusion of operations research in Britain occurred only after 1960, when operations researchers could present themselves as credible and legitimate gatekeepers to computer technologies (Kirby, 2000; Hannah, 1983).

From the early 1960s until the late 1970s, the metaphor of markets as information flows was largely confined to a marginal set of forms of market-making within British finance. Undoubtedly the most prominent of all was the material work performed by technologists around the infrastructures of the market. For these technologists, the informatic metaphor was a conceptual inheritance of their experience in other areas of practice/expertise, including the design of military aircraft control systems (e.g. George Hayter) and the development of real-time computing and telecommunications networks (e.g. Peter Bennett).

Perhaps not surprisingly, the informatic metaphor was central to the worldviews of the leading technologists at the London Stock Exchange. For George Hayter, Director of Technical Services at the London Stock Exchange, the market is

> a series of feedback loops going on [with] different people in the chain […] using feedback from the end of the chain and even from earlier stages to drive their reactions. [With prices, you've] got a series of feedback loops that end up with this wiggly line at the end. It doesn't seem to me like an equilibrium situation at all. It's jerky; it's a whole series of people reacting in a time-series-way to feedback which is also jerky. It's just not that elegant and clean (Hayter interview).

And in the opinion of Peter Bennett, the misbehaviour of markets derives from people failing to 'understand the whole picture' and broader system constraints that generate certain types of feedback (Bennett interview). 'Whenever you have positive feedback', said Bennett, 'you have instabilities'.

> That's a basic in engineering. A lot of people don't understand instability, positive feedback, dynamic systems. A lot of [financial and economic models] out there [are] actually very static, basically data mining, [creating] statistical pictures, as opposed to dynamic modelling (Bennett interview).

By embracing the informatic metaphor and its conceptual corollaries, the technologists posited the market as a system that could be managed through technical-rational solutions. And by making markets apprehensible in technological terms, the informatic metaphor provided epistemic and organisational authority to the armies of technologists that would populate the institutions of finance of the late twentieth century.

As computers and telecommunications expanded throughout the 1970s, the informatic metaphor remained subordinated to worldviews that expressed the market as social, embodied or affective action. Finance was commonly represented in terms of the metaphorical vocabulary of the 'club'. And although market participants understood the potential of information technologies for the securities industry – as exemplified by the attitude and reactions of the Stock Exchange to the introduction of ARIEL in 1974 – market action was largely gauged in terms of the physical encounter of brokers and jobbers, the production of paper tickets, meetings with industrialists and long lunches over port and wine. Arguably, the fact that finance was experienced as social and embodied action outweighed the symbolic power of information flows. The gentlemen were computerised but, despite their new technological appendages, they remained gentlemen. The practices and identities of the communities of finance of the London Stock Exchange continued to be mediated by imaginaries of honour and integrity. More importantly, however, interpersonal knowledge prevailed over mechanised forms of market information. As demonstrated by the history of the adoption of computers in Phillips & Drew and Wood MacKenzie (chapter 5), market participants valued and qualified market information through forms of knowledge produced at the interstices of social connectivities.

The 1980s provided a shift in the market. In 1986 came a putative transformation of the City of London and the Stock Exchange within. With Big

Bang, finance moved onto the screen, partnerships made way to dual-capacity corporations, senior market participants retired, new divisions of labour were created, technologists acquired organisational power, and competition became a global affair. Yet one should not exaggerate the scale of change. The new market was a strictly social affair and, as in the past, connectivities and social forms of market-making remained central to the sense-making practices of financial intermediaries. The recollections of former jobber Michael Johnstone are particularly illustrative. According to Johnstone, early on after Big Bang prices were unnecessarily realistic. Soon enough, however, they became 'cumbersome, innocent, inefficient'. As in the old market, people discovered that they did not have to show the prices they would ultimately deal in. The poker game continued, and rather than transmitting onto the market, prices on the screen became a means for advertising the wares, for showing 'how competitive you could be'. Said Johnstone,

> You can actually deal at a better price than the screen price, anyway, so if you had your relationship [with a market-maker] you could come, [get a better price] and that was your reward for dealing with them (Johnstone interview).

Despite the new medium of the screen, finance remained tied to the evaluative frameworks of the past, where prices were gauged in terms of interpersonal knowledge on the connectivities of the market (chapter 3, 4 and Pardo-Guerra, 2010).

How, then, was the informatic metaphor adopted in London? As explored in the previous chapters, the emergence and consolidation of this metaphor in British finance occurred at the confluence of three distinct processes intersecting several regimes of market marking, adding to an ever-changing repertoire of financial representation.

The first process related to the historically grounded re-materialisation of the marketplace, as examined in chapters 3 and 4. Towards the 1990s, and catalysed by the growth of market information services within the Stock Exchange, the leadership of the Technical Services department had amassed trust and repute within the social and organisational circles of British finance. Consequently, their vocabularies propagated throughout the higher echelons of the institutions of the market. In early

1989, for instance, technical teams were heavily involved in planning the future strategy of the Stock Exchange. For technologists, the challenges of finance were clear: ‘major investors are increasingly aware of the advantages of a world-wide spread of investments, and require suitable mechanisms of achieving this goal’ (Langlands, 1989). To survive in the turbulent environment of the early 1990s, the Stock Exchange thus required ‘competitor and market analysis, technology research and development, appropriate procurement strategy, having the right mix of and profile of technical and business staff, and considerable cooperation between them’ (Newlands, 1989). In sum, the prerequisite of survival was populating the established ethos of the organisation with ‘tried and tested management and scientific techniques’ (Lynch, 1989a). Effectively, technologists and their vocabulary had gained credence in the organisation and, increasingly, the market was understood by the membership of the Stock Exchange in technological terms.

Technologists, however, were not limited to the Stock Exchange. Elsewhere in finance, systems development also re-mediated the relation between market participants and exchange. For Nic Stuchfield of the investment bank BZW, for instance, technology was clearly a competitive factor, and people throughout the City recognised that important parts of the market could be automated. Ventures into automation took numerous forms and occurred in several occasions, including the development of TRADE, BZW’s small order execution service in 1987 (chapter 5). The exodus of technologists from the Stock Exchange in 1992 and the subsequent development of alternative trading platforms (e.g. Tradepoint) further demonstrated that the landscape of finance in the City of London was technological. Engaging with the market now necessitated technological vocabularies and their associated metaphors. Changes in the organisation of finance, coupled to the proliferation of networks, platforms, and technological competencies, had altered the experiential character of the markets in London.

A second process involved the reconfiguration of some of the cognitive tools used by intermediaries in creating the market. Specifically, British varieties of market-making during the 1990s quickly became inscribed in broader cultural

circuits (Thrift, 2005) that included, among other things, informatic metaphors of economic exchange. Economic expertise, for instance, acquired an authoritative presence within financial institutions, prompting the creation of networks and alignments with academic and research institutions that had adopted the canonical version of financial economics (Jovanovic, 2008) as a paradigmatic explanation of the behaviour of stock markets (Dimson interview). The informatic metaphor also arrived as a theoretical convergence between British economists and their American peers.

The third and final process comprised the redefinition of the boundaries of authority between the state, the markets and the public which took the form of the re-regulation of British finance. As examined in chapter 6, the introduction of the Financial Services Act 1986 and of statutory regulation in the 1990s allowed for the stock market to be conceptualised as a rule-governed mechanism amenable to expert control and intervention. Metaphors of transparency from earlier discourses of self-regulation were redefined in technical terms under the statutory system. Economic expertise, in particular, became a source of authoritative claims on the behaviour of the market and, consequently, transparency and market quality were interpreted in an informatic vocabulary. With governmental acquiescence, the market became an informatic machine.

To interpret the rise of the informatic metaphor in British finance as a tale of the discovery of information would therefore misrepresent the nuances of the history presented here and in previous chapters. Indeed, if London grew to see markets as information flows it was not because this metaphor describes their true nature, the essence of economic exchange. Rather, the metaphor matured by coordinating action across domains of market-making, by creating boundaries of economic exchange. Markets in London were *made* informatic by the adoption of technological metaphors of processing, control, transparency and efficiency. But for these metaphors to be intelligible, for these modes of apprehension to mediate market-making activities, material foundations had to be laid, work had to be done, and institutions had to be built. The history of the London Stock Exchange was

necessarily the tale of the creation of these foundations, forms of work and institutions. It is not, however, a saga of efficiency, a legend of the discovery, conquest and eventual domination of our informatic world.

conclusions

8 Conclusions

The chapters in this volume provide a multifaceted approach to the historic transformations surrounding the Big Bang of 27 October 1986. By exploring the twists and turns that ushered these transformations, this volume also provides a critique of the information age in finance and, in particular, of three foundational myths that are often used to explicate the evolution (and, occasionally, to predict the destiny) of global markets – namely, that the information age leads to dematerialisation, disintermediation, and deregulation.

Let the first lesson of this study be that markets are material. Much of the exploration of this volume is in line with a growing body of literature that stresses the critical role of material entities in performing finance (Callon, 1998; MacKenzie, 2009). The history of the Stock Exchange, then, can be represented as a history of technological innovation, a perspective that is lacking in the extant literature on finance. For better or for worse, analyses of the evolution of finance so far have been predominantly the purview of economic and business history, areas that are notably able to black-box technologies in terms of inherent functions, cost/benefit comparisons and technical potentialities. As the literature in science and technology studies has shown for several decades now (MacKenzie et al., 2003; Williams et al., 1996), however, neither the genesis nor the uses of technologies are given by such imperatives. The technological trajectories of the Stock Exchange are only intelligible by understanding the role of a core group of technologists in designing, implementing, and projecting technologies in the marketplace. As such, chapters 3 and 4 complement traditional accounts of the history of British finance by demonstrating the paths taken in constructing the (often ignored) material platforms of the market.

The second lesson is that, as much as they are material, markets hinge on social connectivities. This claim is in line with a strong tradition of economic sociology that has argued for the social embeddednes, or social connectedness, of

economic action. Yet in engaging with this literature, the exploration here presented on the history of the Stock Exchange encountered a pervasive notion that the fundamental cultural transition of 1980s British finance was given by the move from a market culture of 'gentlemanly capitalism' to one of 'global finance'. It might seem, for some, that the death of gentlemanly capitalism signalled the rise of the information age in British finance. While it may be possible to speak of market cultures, this study has opted for adopting the language of social imaginaries. And as shown in chapter 5, the history of the London Stock Exchange's markets is better framed in terms of an ongoing reconstruction of a social imaginary of honour and familiarity than through the thick cultures of the gentlemanly capitalist. Indeed, in showing this ongoing reconstitution, chapter 5 demonstrates that the evolution of London's markets cannot be dissociated from the history of the social connectivities between jobbers, brokers, investors, regulators and members of staff, which were established by and through the practices of intermediation in British finance, and that required the creation of specific imaginaries that served as mechanisms for mediating actions in the marketplace.

The third lesson is similar, in a sense, in so far as it challenges the view of regulatory change as a discontinuous process resulting from a reconfiguration of economic incentives as perceived by the state. On the contrary, regulation is to be understood as part of a constant process of negotiating the boundaries of legitimate action within the social connectivities of finance, a matter that required only relatively lately the overt intervention of the state. The myth of regulation is thus erred, in as much as it fails to capture changes in the conceptualisation of the market, the proliferation of formal rules, and in the adoption and abandoning of specific technical vocabularies within market institutions. The deregulations of the 1980s seem to have entailed more than anything else the creation of novel boundaries within the market, rather than the elimination of controls across the board (Vogel, 1996).

Finally, this volume offers a modest, yet insightful, analytical framework for markets by introducing the notion of a market-making regime. In presenting markets

as entities that cannot be apprehended in their entirety, this volume shows the importance of focusing on specific instances of market-making work. There, chapter 7 highlights the role of metaphors in representing through experience and coordinating action. The case of specific metaphor is analysed, offering some provisional arguments on the changing vocabularies and modes of apprehension of finance. Indeed, while the myths of the information age may have flattened a rich story of social and technological in the City of London, the metaphorical repertoire of information is actively utilised in representing contemporary financial markets.

9 References

Abacus (1962). The Age of Machinery. *Stock Exchange Journal, 7,* 12-14.

Abbott, A. (1991). History and Sociology: The Lost Synthesis. *Social Science History, 15,* 201-238.

Abolafia, M. (1996). *Making Markets: Opportunism and Restraint in Wall Street*. Cambridge, MA: Harvard University Press.

Abrams, P. (1980). History, Sociology, Historical Sociology. *Past & Present, 87,* 3-16.

Ackoff, R. (1956). The Development of Operations Research as a Science. *Operations Research, 4,* 265-295.

Allen, F., McAndrews, J., & Strahan, P. (2002). E-Finance: An Introduction. *Journal of Financial Services Research, 22,* 5-27.

Althaus, F. R. (1962). The Public Face of the Stock Exchange. *The Stock Exchange Journal, 7,* 4.

Anonymous (1947). British Corporate Law Reform. *The Yale Law Review, 56,* 1383-1403.

Anonymous (1955). Reviews. *The Stock Exchange Journal, 1,* 53.

Anonymous (1955a). The Cairo House. *The Stock Exchange Journal, 1,* 49-50.

Anonymous (1955b). For and Against Rebuilding. *Stock Exchange Journal, 1,* 101-103.

Anonymous (1958). Editorial Notes. *The Stock Exchange Journal, 4,* 3-4.

Anonymous (1960a). Stock Exchange News. *The Stock Exchange Journal, 6,* 2-3.

Anonymous (1960b). Towards Mechanization: Methods of Providing Bargain Information to Machine Systems. *Stock Exchange Journal, 5,* 8.

Anonymous (1962). Stock Exchange Notes. *The Stock Exchange Journal, 7,* 5-6.

Anonymous (1966). House Notes. *Stock Exchange Journal, 11,* 1.

Anonymous (1969a). House Notes. *Stock Exchange Journal, 14,* 1-3.

Anonymous (1969b). House notes. *Stock Exchange Journal, 14,* 1-2.

Anonymous (1970a). House Notes. *Stock Exchange Journal, 15,* 1.

Anonymous (1970b). House Notes. *Stock Exchange Journal, 20,* 26-27.

Anonymous (1970c). Stock Exchange Information Computerised. *Accountancy, 81,* 606-607.

Anonymous (1974). The Stock Exchange's New Computer. *DataSystems, 15,* 10-12.

Anonymous (1986). As the City of London Prepares for Monday's Switchover...

Anonymous (1986a). Monday is D-Day for the Stock Exchange. *Computer Weekly*, October 23

Anonymous (1986b). A Huge Sigh of Relief was Heard Throughout the City of London. *Computing*, October 2.

Anonymous (1986c). City Systems. *Accountancy, 129,* 128.

Anonymous (1989). View from City Road: all at Sea with SEAQ. *The Independent*, January 7.

Anonymous (1992). Andersen to Operate Exchange Computers. *The Times,* April 14

Anonymous (1995). Tradepoint Makes Quiet Debut. *The Scotsman,* September 22

Computer Weekly, October 23

Armour, J. & Skeel, D. (2006). *Who Writes the Rules for Hostile Takeovers, and Why? The Peculiar Divergence of US and UK Takeover Regulations* (Rep. No. 331). Cambridge: Centre for Business Research, University of Cambridge.

Armstrong, F. E. (1934). *The Book of the Stock Exchange*. London: Sir Isaac Pitman & Sons, Ltd.

Arrow, K. (2001). The Five Most Significant Developments in Economics of the Twentieth Century. *European Journal of the History of Economic Thought, 8,* 298-304.

Arrow, K. (1959). *Economic welfare and the allocation of resources for invention* (Rep. No. P-1856-RC). Santa Monica: The RAND Corporation.

Atkinson, R. (2004). *The Past and Future of America's Economy: Long Waves of Innovation that Drive Cycles of Growth*. Chelthenham: Edward Elgar.

Attard, B. (2000). Making a Market. The Jobbers of the London Stock Exchange 1800-1986. *Financial History Review, 7,* 5-24.

Attneave, F. (1959). *Applications of Information Theory to Psychology: a Summary of Basic Concepts, Methods and Results*. Oxford: Henry Holt.

Augar, P. (2000). *The Death of Gentlemanly Capitalism*. London: Penguin Books.

Austin, J. L. (1975). *How to Do Things With Words*. Oxford: Oxford University Press.

Bagrit, L. (1962). Scientific Development. *The Stock Exchange Journal, 8,* 12-13.

Bakker, G. (2006). *Trading Facts: Arrow's Fundamental Paradox and the Emergence of Global News Networks, 1750-1900* (Rep. No. 17/07). London School of Economics.

Banelj, N. (2009). Emotions in Economic Action and Interaction. *Theory & Society, 38,* 347-366.

Barber, B. & Odean, T. (2001). The Internet and the Investor. *Journal of Economic Perspectives, 15,* 41-54.

Barnes, B. (1983). Social Life as Bootstrapped Induction. *Sociology, 17,* 524-545.

Barnes, B. (1995). *The Elements of Social Theory*. London: UCL Press.

Barnes, B. (1988). *The Nature of Power*. Cambridge: Polity Press.

Barnes, B. & Dupre, J. (2008). *Genomes and What to Make of Them*. Chicago: The University of Chicago Press.

Barnes, W. (1989). *Managerial Catalyst: The Story of the London Business School, 1964-1989*. London: Paul Chapman Publishing.

Barthes, R. (1993). *Mythologies*. London: Vintage.

Batiz-Lazo, B. & Wardley, P. (2007). Banking on Change: Information Systems and Technologies in UK High Street Banking, 1919-1969. *Financial History Review, 14,* 177-205.

Beaver, W. H. (1968). The Information Content of Annual Earnings Announcements. *Journal of Accounting Research, 6,* 67-92.

Bekenstein, J. (1973). Black Holes and Entropy. *Physical Review D, 7,* 2333-2346.

Bekenstein, J. (1975). Statistical Black-Hole Thermodynamics. *Physical Review D, 12,* 3077-3085.

Bell, D. (1973). *The Coming of Post-Industrial Society*. New York: Basic Books.

Bell, D. (1977). The Future World Disorder: The Structural Context of Crises. *Foreign Policy, 27,* 109-135.

Bennett, M (1959). Putting the House in Order: Junior Members' Views Expressed by M. Bennett. *Stock Exchange Journal, 4,* 7-10.

Bennett, P. (1984). *U.K. Stock Exchange Information Services Developments: A Statement of Intent* London: Information Services Division, The Stock Exchange.

Berman, H. D. (1963). *The Stock Exchange: an Introduction for Investors*. London: Sir Isaac Pitman & Sons Ltd.

Beunza, D. & Stark, D. (2004). Tools of the Trade: the Socio-Technology of Arbitrage in a Wall Street Trading Room. *Industrial and Corporate Change, 13,* 369-400.

Bijker, W. & Law, J. (1992). *Shaping Technology/Building Society: Studies in Sociotechnical Change*. Cambridge, MA: MIT Press.

Bingham, W. & Moore, B. (1959). *How to Interview*. New York: Harper.

Bissell, Tom (2008, November 3). The grammar of fun: CliffyB and the world of the video game. *The New Yorker,* 78-84.

Black, F. (1971). Toward a Fully Automated Stock Exchange. *Financial Analysts Journal, 27,* 23-87.

Black, J. (1997). *Rules and Regulators*. Oxford: Oxford University Press.

Blaikie, N. (2000). *Designing Social Research: the Logic of Anticipation*. Cambridge: Polity Press.

Bloor, D. (1991). *Knowledge and Social Imagery*. Chicago: University of Chicago Press.

Bloor, D. (1997). *Wittgenstein, Rules and Institutions*. London: Routledge.

Boal, I. & Lakoff, G. (1995). Body, Brain and Communication. In J.Brook & I. Boal (Eds.), *Resisting Virtual Life: The Culture and Politics of Information* (San Francisco: City Lights.

Boltanski, L. & Thevenot, L. (1999). The Sociology of Critical Capacity. *European Journal of Social Theory, 2,* 359-377.

Boltanski, L. & Thevenot, L. (2006). *On Justification: Economies of Worth*. Princeton: Princeton University Press.

Boulding, K. (1956). General Systems Theory-The Skeleton of Science. *Management Science, 2,* 197-208.

Bourdieu, P. (1987). The Force of Law: Toward a Sociology of the Juridical Field. *The Hastings Law Journal, 38,* 814-853.

Bousquet, A. (2009). *The Scientific Way of Warfare: Order and Chaos on the Battlefields of Modernity*. New York: Columbia University Press.

Brodhurst, S. (1897). *The Law and Practice of the Stock Exchange*. London: William Clowes and Sons, Ltd.

Brown, Malcolm (1986). The Big Bang: When the Heat is on. *The Sunday Times*, October 26

Buck, S. P. (2008). EPIC and the use of state tables: recollections 30 years on, Unpublished Manuscript

Butterworth, J. E. (1972). The Accounting System as an Information Function. *Journal of Accounting Research, 10,* 1-27.

Cain, P. J. & Hopkins, A. G. (1986a). Gentlemanly Capitalism and British Expansion Overseas I. The Old Colonial System, 1688-1850. *The Economic History Review, 39,* 501-525.

Cain, P. J. & Hopkins, A. G. (1986b). Gentlemanly Capitalism and British Expansion Overseas II: New Imperialism, 1850-1945. *The Economic History Review, 40,* 1-26.

Caliskan, K. (2005). *Making a Global Commodity: the Production of Markets and Cotton in Egypt, Turkey and the United States.* Thesis, New York University.

Caliskan, K. & Callon, M. (2009). Economization, Part 1: Shifting the Attention from the Economy Towards the Processes of Economization. *Economy & Society, 38*, 369-398.

Callon, M. (1998). *The Laws of the Markets*. London: Blackwell Publishers.

Callon, M. (1986). Elements of a Sociology of Translation: Domestication of the Scallops and the Fishermen of St Brieuc Bay. In J.Law (Ed.), *Power, Action and Belief: a new Sociology of Knowledge?* (pp. 196-233). London: Routledge.

Campbell-Kelly, M. & Aspray, W. (1996). *Computer: a History of the Information Machine*. New York: Basic Books.

Carruthers, B. & Stinchcombe, A. (1999). The Social Structure of Liquidity: Flexibility, Markets, and States. *Theory and Society, 28,* 353-382.

Cassis, Y. (1985). Bankers in English Society in the Late Nineteenth Century. *The Economic History Review, 38,* 210-229.

Castells, M. (2000a). Information Technology and Global Capitalism. In A. Giddens & W. Hutton (Eds.), *On the Edge: Living with Global Capitalism* (London: Jonathan Cape.

Castells, M. (2000b). Materials for an Exploratory Theory of the Network Society. *British Journal of Sociology, 51*, 5-24.

Castells, M. (2000c). *The Rise of the Network Society*. (Second Edition ed.) Oxford: Blackwell Publishing.

Castells, M. (2004). An Introduction to the Information Age. In F.Webster (Ed.), *The Information Society Reader* (pp. 138-164). London: Routledge.

Cerny, P. (1994). The Dynamics of Financial Globalization: Technology, Market Structure and Policy Response. *Policy Sciences, 27*, 319-342.

Certeau, M. (1988). *The Writing of History*. Ithaca: Columbia University Press.

Chandler, A. & Cortada, J. (2000). *A Nation Transformed by Information*. Oxford: Oxford University Press.

Chapman, C. (1988a). *How the Stock Exchange Works: City Life After the Big Bang and the Great Crash*. London: Hutchinson Business Books.

Chapman, S. D. (1988b). Reply to Youssef Cassis. *The British Journal of Sociology, 39*, 121-126.

Chapman, S. D. (1986). Aristocracy and Meritocracy in Merchant Banking. *The British Journal of Sociology, 37*, 182-193.

Checkland, S. G. (1957). The Mind of the City, 1870-1914. *Oxford Economic Papers, 9*, 261-278.

Claessens, S., Glaessner, T., & Klingebeil, D. (2002). Electronic Finance: Reshaping the Financial Landscape Around the World. *Journal of Financial Services Research, 22*, 29-61.

Clark, Michael and Thomson, Richard (1986). Big Bang Anger Over Faults on Rehearsal Day. *The Times*, 20 October

Clarke, M. (2000). *Regulation: The Social Control of Business between Law and Politics*. Houndsmill: MacMillan Press Ltd.

Cobbett, D. (1961). Inspiration or Information? *The Stock Exchange Journal, 6*, 10-11.

Cobbett, D. (1986). *Before the Big Bang: Tales of the Old Stock Exchange*. Portsmouth: Milestone Publications.

Cobbold, C. F. (1955). Foreword. *The Stock Exchange Journal, 1*, 3.

Coe, N. E., Hedley, K. J., & Longley-Cook, L. H. (1948). Punched-Card Equipment. *Journal of the Institute of Actuaries, 74*, -246.

Coleman, D. C. (1973). Gentlemen and Players. *The Economic History Review, 26,* 92-116.

Collins, H. & Evans, R. (2002). The Third Wave of Science Studies. *Social Studies of Science, 32,* 235-296.

Colombo, U. (1988). The Technology Revolution and the Restructuring of the Global Economy. In J.Muroyama & G. Stever (Eds.), (pp. 23-32). Washington D.C.: National Academies Press.

Coopers & Lybrand (1988). *The Financial Services Act 1986: A Guide to the Act and the Issues for Management*. London: Kogan Page.

Cortada, J. (2005). *The Digital Hand: How Computers Changed the Work of American Financial, Telecommunications, Media and Entertainment Industries.* Oxford: Oxford University Press.

Council of the Stock Exchange (1984). *The Stock Exchange: A Discussion Paper* London.

Council of the Stock Exchange (1973). ARIEL - the Council's View. *Stock Exchange Journal, 23,* 6.

Courtney, C. & Thompson, P. (1996). *City Lives: the Changing Voices of British Finance*. London: Methuen.

Cox, P. (1985). SEAQ International: the Birth of an Electronic Marketplace. In Computers in the City (Ed.), *Computers in the City: Financial Trading Systems* (pp. 137-149). London: Online Publications.

Croley, S. (1988). Theories of Regulation: Incorporating the Administrative Process. *Columbia Law Review, 98,* 1-168.

Cummings, G. (1957). More Information for Stockholders. *The Stock Exchange Journal, 3,* 48-49.

Daedalus (1960). Mechanization. *Stock Exchange Journal, 5,* 98.

David, P. (1985). Clio and the Economics of QWERTY. *American Economic Review, 75,* 332-337.

Davis, B. (1979). *Business Finance and the City of London*. Cox & Wyman, Ltd.

Day, Mark (1956). The Mechanized Office: New Methods for Old Problems. *Stock Exchange Journal, 2,* 12-15.

Day, R. (2000). The 'Conduit Metaphor' and the Nature and Politics of Information Studies. *Journal of the American Society for Information Science, 51,* 805-811.

den Hertog, J. (2000). General Theories of Regulation. In B. Bouckaert & G. De Geest (Eds.), *Encyclopedia of Law and Economics* (pp. 223-270). Cheltenham: Edward Elgar.

Drummond, H. (1996). *Escalation in Decision-making: The Tragedy of Taurus*. Oxford: Oxford University Press.

Duguid, C. (1913). *The Stock Exchange*. London: Methuen & Co. Ltd.

Durkheim, E. (1966). *The Rules of Sociological Method*. New York: The Free Press.

Earle, A. (1968). The London Graduate School of Business Studies. *The Stock Exchange Journal, 13*, 14-16.

Economist (1995). London's market misfit. *Economist*.

Edwards, J. R. (1989). *A History of Financial Accounting*. London: Routledge.

Edwards, P. (1996). *The Closed World: Computers and the Politics of Discourse in Cold War America*. Cambridge, MA: MIT Press.

F.S.G. (1957). The Stock Exchange 'I' corps: Some Sidelights on the Collection and Distribution of Information. *The Stock Exchange Journal, 2*, 104-106.

Fama, E. (1965). Tomorrow on the New York Stock Exchange. *The Journal of Business, 38*, 285-299.

Fama, E. (1970). Efficient Capital Markets: a Review of Theory and Empirical Work. *Journal of Finance, 25*, 383-417.

Fedida, S. & Malik, R. (1979). *The Viewdata Revolution*. New York: Halsted Press.

Financial Services Authority (2009). *The Turner Review: A Regulatory Response to the Global Banking Crisis* London: Financial Services Authority.

Flanders, Stephanie (2009). The Economist's New Clothes. *Stephanomics*, November 30

Fleck, J. (2003). Learning by Trying: the Implementation of Configurational Technology. In D.MacKenzie & J. Wajcman (Eds.), *The Social Shaping of Technology* (pp. 244-257). Open University Press: Maidenhead.

Fligstein, N. (2001). *The Architecture of Markets: an Economic Sociology of Twenty-First Century Capitalist Societies*. Princeton and Oxford: Princeton University Press.

Fligstein, N. (1996). Markets as Politics: a Political-Cultural Approach to Market Institutions. *American Sociological Review, 61*, 656-673.

Fortun, M. & Schweber, S. S. (1993). Scientists and the Legacy of World War II: the Case of Operations Research (OR). *Social Studies of Science, 23,* 595-642.

Foucault, M. (1977). *Discipline and Punish: The Birth of the Prison*. New York: Penguin Books.

Foucault, M. (2002). *The Archaeology of Knowledge*. London: Routledge.

Fox-Keller, E. (2002). *Making Sense of Life: Explaining Biological Development with Models, Metaphors, and Machines*. Cambridge, MA: Harvard University Press.

French, S. & Leyshon, A. (2004). The New, New Financial System? Towards a Conceptualization of Financial Reintermediation. *Review of International Political Economy, 11,* 263-288.

Galison, P. (1994). The Ontology of the Enemy: Norbert Weiner and the Cybernetic Vision. *Critical Inquiry, 21,* 228-266.

Garbade, K. & Silber, W. (1978). Technology, Communication and the Performance of Financial Markets: 1840-1970. *The Journal of Finance, 33,* 819-832.

Garcia-Parpet, M.-F. (2007). The Social Construction of a Perfect Market: the Strawberry Auction Market in Fontaine-en-Solonge. In D.MacKenzie, F. Muniesa, & L. Siu (Eds.), *Do Economists Make Markets?* (pp. 20-53). Princeton: Princeton University PRess.

Geddes, P. (1987). *Inside the Bank of England*. London: Boxtree.

Geiss, C. (2004). *Wall Street: A History, from its Beginnings to the Fall of Enron*. Oxford: Oxford University Press.

Gemmill, G. (1996). Transparency and Liquidity: A Study of Block Trades on the London Stock Exchange Under Different Publication Rules. *The Journal of Finance, 51,* 1765-1790.

Gibson, G. (1889). *The Stock Exchanges of London Paris and New York: a Comparison*. New York & London: G. P. Putnam's Sons.

Gibson, JJ. (1977) 'The Theory of Affordances' in Shaw, R and Bransford, J. *Perceiving, Acting and Knowing* Hillsdale: Erlbaum, 67-82

Goffman, E. (1990). *The Presentation of Self in Everyday Life*. New York: Penguin.

Goodison, N. (1986a). The Big Bang: Taking on the world. *The Sunday Times,* October 26

Goodison, N. (1986b). The Reform of the London Market. *The Stock Exchange Quarterly, 1986,* 21-23.

Gower, L. C. B. (1984). *Review of Investor Protection: Part 1*. London: Her Majesty's Stationary Office.

Granovetter, M. (1985). Economic Action and Social Structure: the Problem of Embeddedness. *The American Journal of Sociology,* 91, 481-510.

Grant, A. (1983). Computing and Dealing Decisions in Stocks and Shares. In Computers in the City (Ed.), *Computers in the City: Proceedings of the International Conference, London* (Northwood: Online.

Griffin, L. (1995). How is Sociology Informed by History? *Social Forces,* 73, 1245-1254.

Grimm, Ed (1977). London Town. *IBM THINK Magazine*.

Grossman, S. (1981). An Introduction to the Theory of Rational Expectations Under Asymmetric Information. *The Review of Economic Studies,* 41, 541-559.

Grundfest, J. (1988). *International cooperation in securities enforcement: a new United States initiative* Washington, D.C.: U.S. Securities and Exchange Commission.

Guston, D. (2001). Boundary Organizations in Environmental Policy and Science: an Introduction. *Science, Technology & Human Values, 26,* 399-408.

Hacking, I. (1983). *Representing and Intervening*. Cambridge: Cambridge University Press.

Hacking, I. (1998). Canguillem Amid the Cyborgs. *Economy & Society, 27,* 202-216.

Hall, S. (2007). 'Relational marketplaces' and the Rise of Boutiques in London's Corporate Finance Industry. *Environment and Planning A, 39,* 1838-1854.

Hall, S. (2006). What counts? Exploring the Production of Quantitative Financial Narratives in London's Corporate Finance Industry. *Journal of Economic Geography, 6,* 661-678.

Hamilton, A. (1986). *The Financial Revolution*. New York: Free Press.

Hamilton, J. D. (1986). *Stockbroking Tomorrow*. London: MacMillan.

Han Kim, E., Morse, A., & Zingales, L. (2006). What Has Mattered to Economics Since 1970. *Journal of Economic Perspectives, 20,* 189-202.

Hannah, L. (1983). *The Rise of the Corporate Economy*. London: Methuen.

Hawking, S. (2005). Information Loss in Black Holes. *Physical Review D, 72*.

Hayek, F. (1948). *Individualism and Economic Order*. Chicago: The University of Chicago Press.

Hayter, G. A. (1983). The Stock Exchanges Integrated Data Network - A Service for the Securities Industry. In *Computers in the City* (pp. 175-188). London: Online Publications.

Hayter, G. A. (1984). The New Market Machinery: System Strategies for a Changing Market Place. *The Stock Exchange Quarterly, 1984*.

Heath, C. & Luff, P. (2007). Ordering Competition: the Interactional Accomplishment of the Sale of Art and Antiques at Auction. *The British Journal of Sociology, 58*, 63-85.

Hennessy, E. (1995). The Governors, Directors and Management of the Bank of England. In R.Roberts & D. Kynaston (Eds.), *The Bank of England: Money, Power & Influence, 1694-1994* (pp. 185-216). Oxford: Oxford University Press.

Herford, R. H. (1956). The Reformation. *The Stock Exchange Journal, 1*, 74.

Hirst, F. (1932). *The Stock Exchange: A short Study of Investment and Speculation*. London: Thornton Butterworth, Ltd.

HM Stationary Office. (2000). Financial Services and Markets Act. HM Stationary Office.

Hobbs, D. (1974). The Development of a Practical Share Evaluation Model. *The Statistician, 23*, 31-56.

Hobsbawm, E. (2008). Introduction: Inventing traditions. In E.Hobsbawm & T. Ranger (Eds.), *The Invention of Tradition* (Cambridge: Cambridge University Press.

House Commerce Committee. (1961). Securities Market Investigation. 87-1. House Commerce Committee.

House of Commons (2009). *Banking Crisis: Regulation and Supervision* London: The Stationery Office Ltd.

Hughes, M. (1971). Shares Prices by Push Button Catch On. *Stock Exchange Journal, 21*, 24-25.

Hutchins, E. (1995). *Cognition in the Wild*. Cambridge: MIT Press.

Hutton, W. (1996). *The State We're In*. London: Vintage.

Ingham, G. (1995). British Imperialism: Merchants, Empire and Decline. *Social History, 20*, 339-354.

Jacquillat, B. & Gresse, C. (1998). The Diversion of Order Flow on French Stocks from CAC to SEAQ International: a Field Study. *European Financial Management, 4,* 121-142.

Jameson, F. (1997). Culture and Financial Capital. *Critical Inquiry, 24,* 246-265.

Jenkins, A. (1973). *The Stock Exchange Story*. London: Heinemann.

Jenkins, Michael (1974). TALISMAN - a New Settlement System. *Stock Exchange Journal, 24,* 6-9.

Jensen, M. (1978). Some Anomalous Evidence Regarding Market Efficiency. *Journal of Financial Economics, 6,* 95-101.

Johnson, B. D. (1974). NMW-The Brokers' Computer Company. *The Stock Exchange Journal, 24,* 24-25.

Johnson, Dean (1908). If a Ban Should be Put on Speculation. *New York Times,* March 1.

Johnston, A. (2007). Takeover Regulation: Historical and Theoretical Perspectives on the City Code. *Cambridge Law Journal, 66,* 422-460.

Joint Study Group on Computerised Gilt Settlement (1980). *Book Entry Transfer of UK Government Securities* London: The Stock Exchange.

Josephs, M. (1979). *Technology and the Future of Stockbroking: a Prospect for the 1980s*. London: London Stock Exchange.

Jovanovic, F. (2008). The Construction of the Canonical History of Financial Economics. *History of Political Economy, 40,* 213-242.

JP Morgan. (2006). Investment Banking? Brochure.

Junne, G., Komen, J., & Tomei, F. (1989). Dematerialisation of Production: Impact on Raw Material Exports of Developing Countries. *Third World Quarterly, 11,* 128-142.

Kallinikos, J. (2002) 'Reopening the Black Box of Technological Artefacts and Human Agency' In: Applegate, L, Galliers R.D. and Gross, J.I.D. (Eds.) *Twenty-third International Conference on Information Systems* 287–294.

Kallinikos, J. (2004) 'Deconstructing Information Packages: Organizational and Behavioural Implications of ERP Systems' *Information, Technology & People,* 17, 1, 8-30.

Kander, A. (2005). Baumol's Disease and the Dematerialization of the Economy. *Ecological Economics, 55,* 119-130.

Kandiah, M. D. (1999). Witness Seminar I 'Big bang': the October 1986 Market Deregulation. *Contemporary British History, 13,* 100-132.

Kay, J. & Vickers, J. (1988). Regulatory Reform in Britain. Economic Policy 3, 285-351.

Kay, L. (1995). Who Wrote the Book of Life: Information and the Transformation of Molecular Biology, 1945-1955. *Science in Contex, 8,* 609-634.

Keen, G. (1966). Stock Exchange computer one. *Stock Exchange Journal, 11,* 12-13.

Keith, C. & Grody, A. (1988) 'Electronic Automation at the New York Stock Exchange' In Guile, B. and Quinn, J. B. (Eds.) *Managing Innovation: Cases From the Services Industries* Washington, D.C.: National Academy Press, 1988)

Kendall, M. G. (1960). *The Stamp Memorial Lecture 1960: New Prospects in Economic Analysis*. London: The Athlone Press.

King, A. (1990). *Global Cities: Post-Imperialism and the Internationalization of London*. London: Routledge.

Kintzele, J. (1988). Man, Money and Time. Logic of Credit: Logic of Modernity? *Design Issues, 4,* 131-140.

Kirby, M. (2000). Operations Research Trajectories: The Anglo-American Experience from the 1940s to the 1990s. *Operations Research, 48,* 661-670.

Klamer, A. & Leonard, T. (1994). So What's an Economics Metaphor? In P.Mirowski (Ed.), *Natural Images in Economic Thought: Markets Read in Tooth and Claw* Cambridge: Cambridge University Press.

Knorr Cetina, K. & Bruegger, U. (2002). Global Microstructures: the Virtual Societies of Financial Markets. *American Journal of Sociology, 107,* 905-950.

Knorr Cetina, K. & Preda, A. (2001). The Epistemization of Economic Transactions. *Current Sociology, 49,* 27-44.

Knorr Cetina, K. & Preda, A. (2005). *The Sociology of Financial Markets*. Oxford: Oxford University Press.

Knorr Cetina, K. & Preda, A. (2007). The Temporalization of Financial Markets: from Network to Flow. *Theory, Culture & Society, 24,* 116-138.

Knorr Cetina, K. & Bruegger, U. (2000). The Market as an Object of Attachement: Exploring Postsocial Relations in Financial Markets. *Canadian Journal of Sociology, 25,* 141-168.

Knorr Cetina, K. & Bruegger, U. (2002). Traders' Engagement with Markets: A Postsocial Relationship. *Theory, Culture & Society, 19,* 161-185.

Krulee, G. (1954). Information Theory and Man-Machine Systems. *Operations Research, 2,* 320-328.

Kusch, M. (2002). *Knowledge by Agreement: The Programme of Communitarian Epistemology*. Oxford: Oxford University Press.

Kynaston, D. (2002). *The City of London: a Club no More 1945-2000*. London: Pimlico.

Kynaston, D. (1991). *Cazenove & Co: a History*. London: B.T. Batsford.

Lakoff, G. (1992). The Theory of Contemporary Metaphor. In A.Ortony (Ed.), *Metaphor and Thought* Cambridge: Cambridge University Press.

Lakoff, G. & Johnson, M. (2003). *Metaphors We Live By*. Chicago: University of Chicago Press.

Lander, R. (1986). *The Times*, October 18.

Langevoort, D. (1998). Angels on the Internet: the Elusive Promise of 'Technological Disintermediation' for Unregistered Offerings of Securities. *The Journal of Small & Emerging Business Law, 2,* 1-26.

Langlands, M. W. (1989). *The International Stock Exchange Strategic Plan 1990/91-1993/94: Business and Political Forces* London.

Lash, S. (2002). *Critique of Information*. London: SAGE Publications, Ltd.

Latham, R. & Sassen, S. (2005). *Digital Formations*. Princeton: Princeton University Press.

Latour, B. (1992). Where Are the Missing Masses? The Sociology of a Few Mundane Artifacts. In W.Bjiker & J. Law (Eds.), *Shaping Technology/Building Society: Studies in Sociotechnical Change* (Cambridge, MA: MIT Press.

Law, J. (1987). Technology and Heterogeneous Engineering: the Case of Portuguese Expansion. In W.Bijker, T. Hughes, & T. Pinch (Eds.), *The Social Construction of Technological Systems: New Directions in the Sociology and History of Technology* (Cambridge, MA: MIT Press.

Lawrenson, J. & Barber, L. (1986). *The Price of Truth: the Story of the Reuters Millions*. London: Shere Books Limited.

Lee, L. C. & Bedford, N. M. (1969). An Information Theory Analysis of the Accounting Process. *The Accounting Review, 44*, 256-275.

Lee, R. (2002). *What is an Exchange? The Automation, Management and Regulation of Financial Markets*. Oxford: Oxford University Press.

Lee, R. (1999). Property Rights in Price and Quote Information. In B.Bouckaert & G. De Geest (Eds.), *Encyclopaedia of Law and Economics* (pp. 315-331). Ghent: Edward Elgar.

Leigh Star, S. & Griesemer, J. (1989). Institutional Ecology, 'Translations' and Boundary Objects: Amateurs and Professionals in Berkeley's Museum of Vertebrate Zoology, 1907 - 1939. *Social Studies of Science, 19*, 387-420.

Lie, J. (1997). Sociology of Markets. *American Review of Sociology, 23*, 341-369.

Lisle-Williams, M. (1984a). Beyond the Market: the Survival of Family Capitalism in the English Merchant Banks. *The British Journal of Sociology, 35*, 241-271.

Lisle-Williams, M. (1984b). Merchant Banking Dynasties in the English Class Structure: Ownership, Solidarity and Kinship in the City of London, 1850-1960. *The British Journal of Sociology, 35*, 333-362.

Littlewood, J. (1998). *The Stock Market: 50 Years of Capitalism at Work*. London: Pitman Publishing.

Littlewood, K. (2005). Forecasting and Control of Passenger Booking. *Journal of Revenue and Pricing Management, 4*, 111-123.

Lomax, D. (1987). *London Markets After the Financial Services Act*. London: Butterworths.

Lord Ritchie of Dundee (1963). The New Stock Exchange. *Stock Exchange Journal, 8*, 4-7.

Lupton, T. & Wilson, C. S. (1959). The Social Background and Connections of "Top Decision Makers". *The Manchester School, 27*, 30-51.

Lynch, P. T. (1989a). *The International Stock Exchange Strategic Plan 1990/91 - 1993/94: The Environment Competitive Threats* London.

Lynch, P. (1989b). *Strategic Plan 1990/91-1993/94: The Environment Competitive Threats* London: Strategic Engineering Unit of the International Stock Exchange.

Macey, J. & O'Hara, M. (1999). Regulating Exchanges and Alternative Trading Systems: A Law and Economics Perspective. *The Journal of Legal Studies, 28*, 17-54.

MacKenzie, D. (2004) 'Social Connectivities in Global Financial Markets' *Environment and Planning D: Space and Society*, 22, 1, 83-103

MacKenzie, D. (2006). *An Engine Not a Camera: How Financial models Shape markets*. Cambridge: MIT Press.

MacKenzie, D. (2009). *Material Markets: How Economic Agents are Constructed*. Oxford: Oxford University Press.

MacKenzie, D., Muniesa, F., & Siu, L. (2007). *Do Economists Make Markets? On the Performativity of Economics*. Princeton: Princeton University Press.

MacKenzie, D. & Wajcman, J. (2003). *The Social Shaping of Technology*. Maidenhead: Open University Press.

Maltby, J. (2000). Was the Companies Act 1947 a Response to a National Crisis? *Accounting History, 5,* 31-60.

Mannheim, H. (2001). *Criminal Justice and Social Reconstruction*. London: Routledge.

Mansfield, C. (1967). Work in Progress: the Mechanics of Rebuilding the Stock Exchange. *Stock Exchange Journal, 12,* 17-20.

McCloskey, D. (1983). The Rhetoric of Economics. *Journal of Economic Literature, 21,* 481-517.

McCloskey, D. (1995). Metaphors Economists Live By. *Social Research, 62,* 215-237.

McDowell, L. (1997). *Capital Culture: Gender at Work in the City*. Oxford: Blackwell.

McRae, H. & Cairncross, F. (1973). *Capital City: London as a Financial Centre*. London: Eyre Meuthen.

Menzler, F. A. A. (1958). Stockbroking as a Profession: the Missing Link. *The Stock Exchange Journal, 4,* 7-10.

Merton, R. K. (1948). The Self-Fulfilling Prophecy. *The Antioch Review, 8,* 193-210.

Michie, R. (1998). Insiders, Outsiders and the Dynamics of Change in the City of London Since 1900. *Journal of Contemporary History, 33,* 547-571.

Michie, R. (1999). *The London Stock Exchange: A History*. Oxford: Oxford University Press.

Ming, F., Stallaert, J., & Whinston, A. (2004). The Internet and the Future of Financial Markets. *Communications of the ACM, 43,* 83-88.

Mirowski, P. (1988). *Against Mechanism: Protecting Economics from Science*. Lanham: Rowman & Littlefield.

Mirowski, P. (1999a). Cyborg Agonistes: Economics Meets Operations Research in Mid-Century. *Social Studies of Science, 29,* 685-718.

Mirowski, P. (1999b). *More Heat than Light: Economics as Social Physics, Physics as Nature's Economics*. Cambridge: Cambridge University Press.

Mirowski, P. (2002). *Machine Dreams: Economics Becomes a Cyborg Science*. Cambridge: Cambridge University Press.

Mirowski, P. (2007). Markets Come to Bits: Evolution, Computation and Markomata in Economic Science. *Journal of Economic Behavior & Organization, 63*, 209-242.

Miyazaki, H. (2003). The Temporalities of Markets. *American Anthropologist, 105*, 255-265.

Moran, M. (1988). Thatcherism and Financial Regulation. *Political Quarterly, 59*, 20-28.

Moran, M. (1986). Theories of Regulation and Changes in Regulation: the Case of Financial Markets. *Political Studies, 34*, 185-201.

Moran, M. (2003). *The British Regulatory State: High Modernism and Hyper-Innovation*. Oxford: Oxford University Press.

Morgan, M. & Morrison, M. (1999). *Models as Mediators: Perspectives on Natural and Social Science*. Cambridge: Cambridge University Press.

Morrell, J. G. (1962). Economic Forecasting and Investment Analysis. *The Investment Analyst*.

Morris, M., Sheldon, O., Ames, D., & Young, M. (2007). Metaphors and the Market: Consequences and Preconditions of Agent and Object Metaphors in Stock Market Commentary. *Organizational Behavior and Human Decision Processes, 102*, 174-192.

Mosley, I. (1962). Consolidation of Accounts. *The Investment Analyst, 1*.

Muniesa, F. (2007). Market Technologies and the Pragmatics of Prices. *Economy and Society, 36*, 377-395.

Muniesa, F. & Callon, M. (2005). Economic Markets as Calculative Collective Devices. *Organization Studies, 25*, 1229-1250.

Murphy, M. (1946). Proposed Amendment of British Company Law. *The Accounting Review, 21*, 37-46.

Newlands, A. R. (1989). *The International Stock Exchange Strategic Plan 1990/91 - 1993/94: Impact of Technology* London.

Nieto, M. (2001). Reflections on the Regulatory Approach to E-Finance. In Bank for International Settlements (Ed.), *Electronic Finance: A New Perspective and Challenges* (Basel: BIS Information, Press & Library Services.

Nightingale, R. (1985). Electronics in the City. In Computers in the City (Ed.), *Retailing Financial Services* London: Online.

Norman, D. (1999) ‘Affordances, Conventions and Designs’ *Interactions*, May/June, 38-42

O'Brien, R. (1992). *Global Financial Integration: The End of Geography*. London: The Royal Institute of International Affairs.

O'Hara, M. (1997). *Market Microstructure Theory*. Malden: Blackwell Business.

Office of Fair Trading (1988a). *The International Stock Exchange: A Report by the Director General of Fair Trading to the Secretary of State for Trade and Industry* Office of Fair Trading.

Office of Fair Trading (1988b). *The International Stock Exchange: Dissemination of Company News* Office of Fair Trading.

Office of Fair Trading (1990). *Trade Publication and Price Transparency on the International Stock Exchange* London: Office of Fair Trading.

Office of Fair Trading (1994). *Trade Publication Rules of the London Stock Exchange* London: Office of Fair Trading.

Ogus, A. (2004). *Regulation: Legal Form and Economic Theory*. Portland: Hart Publishing.

Orlikowski, W.J. & Iacono, S.C. (2001) Research commentary: desperately seeking the ’IT’ in IT research—a call to theorizing the IT artifact, *Information Systems Research* 12, 2, 121–134.

Pagano, Margareta (1985). The Big Bang will Really be a Series of Small Pops: Analysis of Technology and the Stock Exchange. *The Guardian,* April 3

Pardo-Guerra, J. P. (2010). Creating Flows of Interpersonal Bits: The Automation of the London Stock Exchange, 1955-1990. *Economy & Society,* 39, 1, 98-124.

Perks, R. & Thomson, A. (1998). *The Oral History Reader*. London: Routledge.

Phillips & Drew. (1968). A Career with Phillips & Drew. London.

Pinch, T. & Swedberg, R. (2008). *Living in a Material World: Economic Sociology Meets Science and Technology Studies*. Cambridge, MA: MIT Press.

Pixley, J. (2002). Financial Organizations, Decisions and Emotions. *British Journal of Sociology, 53,* 41-65.

Platt, D. C. M. (1980). British Portfolio Investment Overseas Before 1870: Some Doubts. *The Economic History Review, 33,* 1-16.

Plender, J. (1987). London's Big Bang in International Context. *International Affairs, 63,* 39-48.

Podolny, J. (1993). A status-based model of market competition. *The American Journal of Sociology, 98,* 829-872.

Porter, T. (1995). *Trust in Numbers: the Pursuit of Objectivity in Science and Public Life.* Princeton: Princeton University Press.

Power, M. (2007). *Organized Uncertainty: Designing a World of Risk Management*. Oxford: Oxford University Press.

Preda, A. (2005). Legitimacy and Status Groups in Financial Markets. *The British Journal of Sociology, 56,* 451-471.

Preda, A. (2008). Technology, Agency and Financial Price Data. In T.Pinch & R. Swedberg (Eds.), *Living in a material world* (pp. 217-252). Cambridge: MIT Press.

Preda, A. (2009). *Framing Finance*. Chicago: Chicago University Press.

Pryke, M. (1991). An International City Going 'Global': Spatial Change in the City of London. *Envrionment and Planing D: Society and Space, 9,* 197-222.

Quality of Markets Unit. (1986a). Quality of Markets: First Report. *Quality of Markets* 1, 1.

Quality of Markets Unit (1986b). Market Making After Big Bang. *Quality of Markets, 1,* 11-13.

Reader, W. (1979). *A House in the City*. London: B.T. Batsford Ltd.

Reader, W. & Kynaston, D. (1998). *Phillips & Drew: Professionals in the City*. London: Robert Hale.

Reddy, M. (1979). The Conduit Metaphor - a Case of Frame Conflict in our Language about Language. In A.Ortony (Ed.), *Metaphor and thought* (pp. 284-297). Cambridge: Cambridge University Press.

Reed, M. (1975). *A History of James Capel & Co*. London: Longman.

Ritchie, J. & Lewis, J. (2003). *Qualitative Research Practice: a Guide for Social Science Students and Researchers*. Thousand Oaks: SAGE Publications.

Rix, M. S. (1950). The Premium on U.S. Dollar Securities. *The Economic Journal, 60,* 686-696.

Roberts, R. (1992). Regulatory Responses to the Rise of the Market for Corporate Control in Britain in the 1950s. *Business History, 34,* 183-200.

Roper, M. (1996). Oral Histories. In B.Brivati, J. Buxton, & A. Seldon (Eds.), *The Contemporary History Handbook* (pp. 345-352). Manchester: Manchester University Press.

Rutterford, J. (2004). From Dividend Yield to Discounted Cash Flow: a History of UK and US Equity Valuation Techniques. *Accounting, Business and Financial History, 14,* 115-149.

S.R.G (1965). The Stock Exchange Communication System. *Stock Exchange Journal, 9,* 18-19.

Saari, C. (1977). The Efficient Capital Market Hypothesis, Economic Theory, and the Regulation of the Securities Industry. *Stanford Law Review, 29,* 1030-1076.

Samuelson, P. (1964). Proof that Properly Anticipated Prices Fluctuate Randomly. *Industrial Management Review, 6,* 41-49.

Sassen, S. (1999). De-Nationalization: Some Conceptual and Empirical Elements. *PoLAR: Political and Legal Anthropology Review, 22,* 1-16.

Sassen, S. (2002). Towards a Sociology of Information Technology. *Current Sociology, 50,* 365-388.

Securities and Exchange Commission (1963). *Report of Special Study of Securities Markets* Washington: US Government Printing Office.

Segre, S. (2008). *A Weberian Analysis of Business Groups and Financial Markets: Trade Relations in Taiwan and South Korea and some Major Stock Exchanges.* Aldershot: Ashgate.

Shannon, C. (1937). *A Symbolic Analysis of Relay and Switching Circuits.* Massachusetts Institute of Technology, Cambridge, MA.

Shannon, C. (1948). A Mathematical Theory of Communication. *The Bell System Technical Journal, 27,* 379-423.

Shiller, R. (1981). Do Stock Prices Move Too Much to be Justified by Subsequent Changes in Dividends? *The American Economic Review, 71,* 421-436.

Sholle, D. (2003). What is Information? The Flow of Bits and the Control of Chaos. In H.Jenkins & D. Thorburn (Eds.), *Democracy and New Media* (pp. 343-364). Cambridge, MA: MIT Press.

Shone, R (1968). The City University. *Stock Exchange Journal, 13,* 14-16.

Simon, H. & Newell, A. (1958). Heuristic Problem Solving: the Next Advance in Operations Research. *Operations Research, 6,* 1-10.

Smith, C. (1989). *Auctions: The Social Construction of Value*. New York: Free Press.

Spiegelberg, R. (1973). *The City: Power Without Accountability*. London: Quartet Books.

Stanley, C. (1994). Speculators: Culture, Economy and the Legitimation of Deviance. *Crime, Law and Social Change, 21,* 229-251.

Stark, D. (2009). *The Sense of Dissonance*. Princeton: Princeton University Press.

Steger, M. (2008). *The Rise of the Global Imaginary: Political Ideologies from the French Revolution to the Global War on Terror*. Oxford: Oxford University Press.

Stigler, G. (1971). The Theory of Economic Regulation. *The Bell Journal of Economics and Management Science, 2,* 3-21.

Strange, S. (1986). *Casino Capitalism*. Oxford: Basil Blackwell.

Summers, L. (1986). Does the Stock Market Rationally Reflect Fundamental Values? *The Journal of Finance, 41,* 591-601.

T.L.H. (1917). Property. Ownership of Stock Quotations. Ticker Service. *University of Pennsylvania Law Review and American Law Register, 65,* 482-485.

Taylor, C. (2004). *Modern social imaginaries*. Durham: Duke University Press.

Teague, S. J. (1980). *The City University: A History*. London: City University.

The Council of The Stock Exchange (1974). *Comments on the Labour Working Party Green Paper on the Reform of Company Law and its Administration* London: The Stock Exchange.

The Council of the Stock Exchange. (1951). My Word is My Bond: The Stock Exchange, Some Questions and Answers. London, St. Clements Press Ltd.

The Economist (2009). Efficiency and Beyond. *The Economist*.

The New York Times (1987, March 13). London to End Trading Floor. *The New York Times*.

The Stock Exchange, L. (1976). Code of Dealing. London, The Council of The Stock Exchange, London.

Theil, H. & Leenders, C. T. (1965). Tomorrow on the Amsterdam Stock Exchange. *The Journal of Business, 38,* 277-284.

Thomas, N. (1991). *Entangled Objects*. Cambridge: Harvard University Press.

Thomas, W.A. (1973) *The Provincial Stock Exchanges* Oxon: Frank Cass and Company Ltd

Thrift, N. (2005). *Knowing Capitalism*. London: SAGE Publications.

Thrift, N. & Leyshon, A. (1994). A Phantom State? The De-Traditionalization of Money, the International Financial System and International Financial Centres. *Political Geography, 13,* 299-327.

Timmons, Heather (2006, October 27). New York Isn't the World's Undisputed Financial Capital. *New York Times*.

Trainer, T. (2001). The "De-Materialisation" Myth. *Technology in Society, 23,* 505-514.

Truell, Peter (1986). Britain's 'Big Bang' Sputters in Practice, Starts Next Week. *The Wall Street Journal*, October 20.

Turing, A. (1936). On Computable Numbers, with an Application to the Entscheidungsproblem. *Proceedings of the London Mathematical Society, 42,* 230-265.

Turner, A. (2009). *Speech to the CBI Annual Conference*.

U.S.Congress, O. o. T. A. (1990). *Trading Around the Clock: Global Securities Markets and Information Technology - Background Paper*. Washington D.C.: Government Printing Office.

Veblen, T. (1917). *An Inquiry Into the Nature of Peace and the Terms of its Perpetuation*. New York: The Macmillan Company.

Vice, A. (1968). Paper Work Log-Jam on Wall Street. *Stock Exchange Journal, 13,* 12-13.

Vogel, S. (1996). *Freer Markets, More Rules: Regulatory Reform in Advanced Industrial Countries*. Ithaca: Cornell University Press.

von Neumann, J. & Morgenstern, O. (1944). *Theory of Games and Economic Behavior*. Princeton: Princeton University Press.

Weaver, D. & Fowler, B. G. N. (1960). The Assessment of Ordinary Industrial Shares. *Journal of the Institute of Actuaries, 86,* 243-295.

Weaver, D. & Hall, M. G. (1967). The Evaluation of Ordinary Shares Using a Computer. *Journal of the Institute of Actuaries, 93,* 165-227.

Webb, R. (2003). Transitory Real-Time Property Rights and Exchange Intellectual Property. *Journal of Futures Markets, 23,* 891-913.

Weber, M. (2000). Stock and Commodity Exchanges. *Theory and Society, 29,* 305-338.

Webster, F. (2006). *Theories of the Information Society*. London: Routledge.

Weiner, N. (1948). *Cybernetics: or Control and Communication in the Animal and the Machine*. Cambridge, MA: MIT Press.

Wells, W. (2000). Certificates and Computers: the Remaking of Wall Street, 1967 to 1971. *Business History Review, 74,* 193-235.

White, H. (2002). *Markets as Networks: Socioeconomic Models of Production*. Princeton: Princeton University Press.

White, R. (1984). Report of Committees: The Review of Investor Protection - The Gower Report. *The Modern Law Review, 47,* 553-566.

Whyte, H. (1924). *The Stock Exchange: its Constitution and the Effects of the Great War*. London: Sir Isaac Pitman & Sons.

Williams, R. & Edge, D. (1996). The Social Shaping of Technology. *Research Policy, 25,* 856-899.

Wolfers, J. & Zitzewitz, E. (2004). Prediction Markets. *The Journal of Economic Perspectives, 18,* 107-126.

Wrenbury, L. (1949). *Buckley on the Companies Acts*. London: Butterworth & Co.

Zaloom, C. (2006a). *Out of the Pits: Traders and Technology from Chicago to London*. Chicago: The University of Chicago Press.

Zukin, S. & DiMaggio, P. (1990). *Structures of Capital: the Social Organization of Economic Life*. Cambridge: Cambridge University Press.

Appendix A. Interviews

Name	Date	Location
Peter **Bennett**	16 July 2007	London
Simon Peter **Buck**	24 September 2007	Dartford
John **Cheine**	8 April 2008	London
Peter **Cox**	28 September 2007	London
Elroy **Dimson**	28 February 2008	London
Scott **Dobbie**	26 February 2008	London
Dugald **Eadie**	10 April 2008	London
Ian **McLelland**	22 October 2007	York
Pete **Harris**	5 September 2007	New York (via telephone)
George **Hayter**	25 October 2007	Gloucester
David **Hobbs**	22 November 2007	London
Michael **Johnstone**	27 February 2008	London
Patrick **Mitford-Slade**	20 November 2007	Hampshire
Michael **Newman**	22 November 2007	London
Barry **Riley**	20 April 2007	Edinburgh
Graham **Ross Russell**	10 April 2008	London
John **Scannell**	21 November 2007	London
Daniel **Sheridan**	26 May 2007	Kent
David **Steen**	24 May 2007	Kent
Nic **Stuchfield**	26 September 2007	London